Railway Maintenance Engineer

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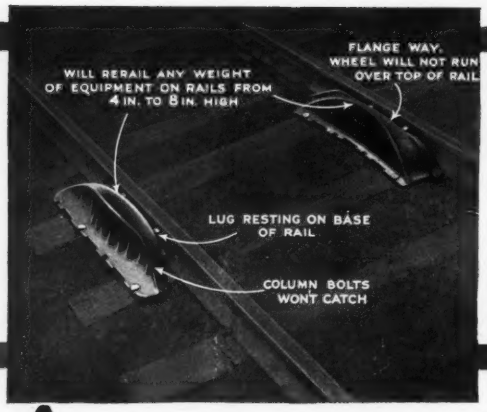

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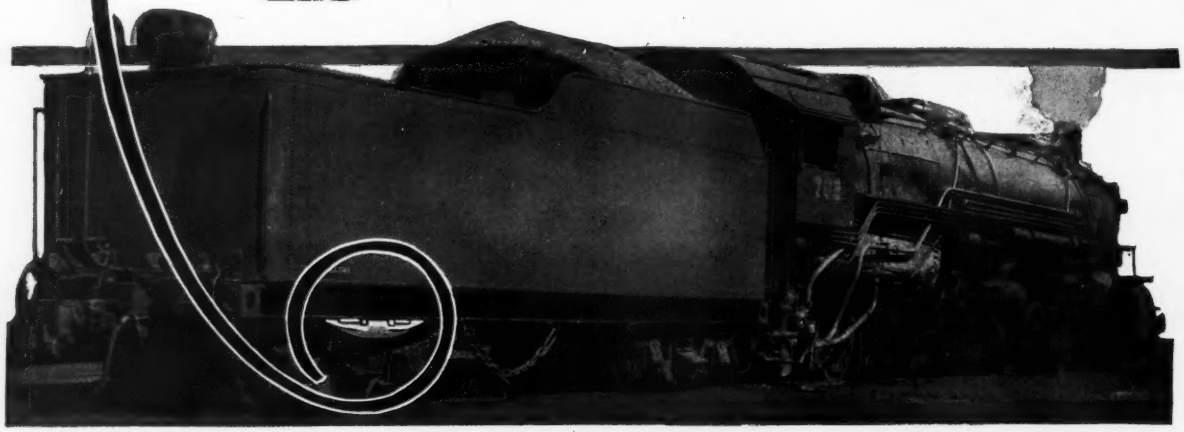

RAILWAY MAINTENANCE ENGINEER
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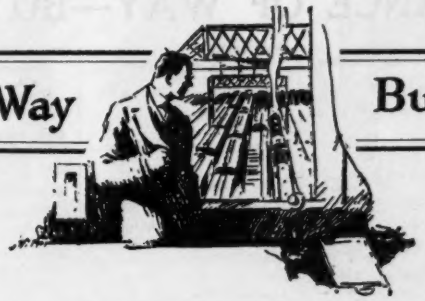

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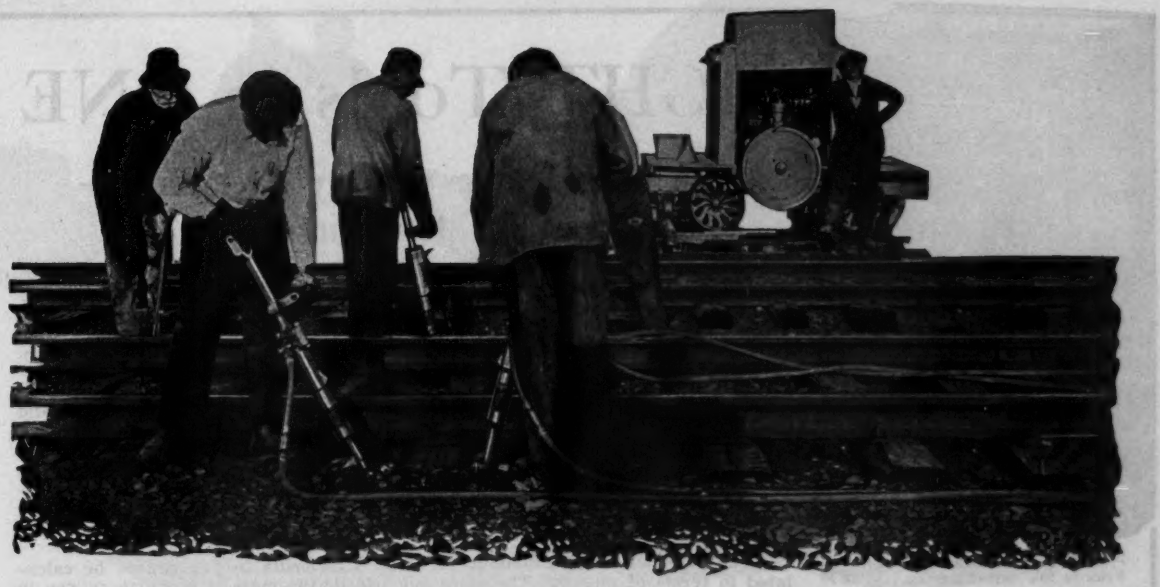

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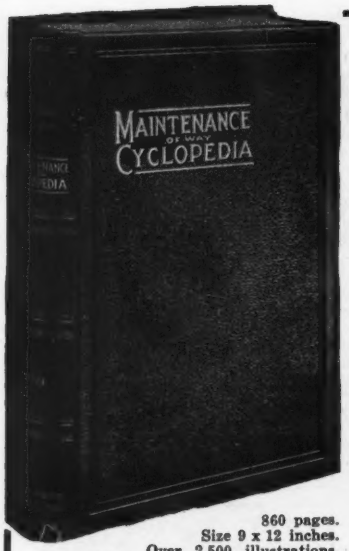

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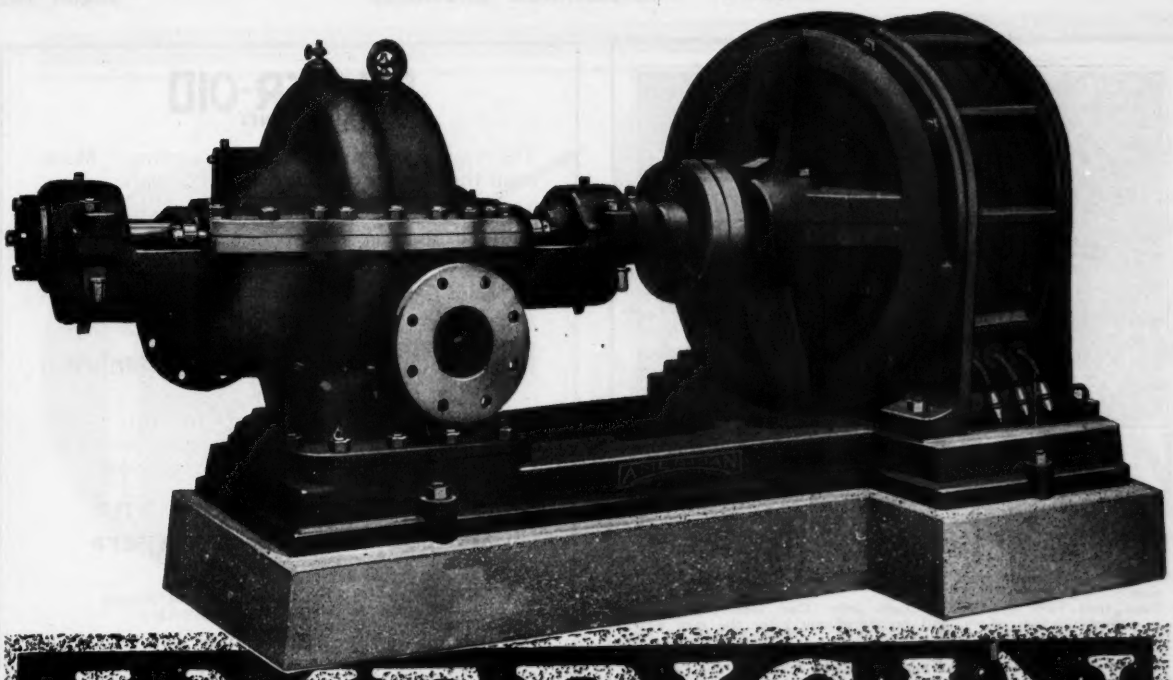

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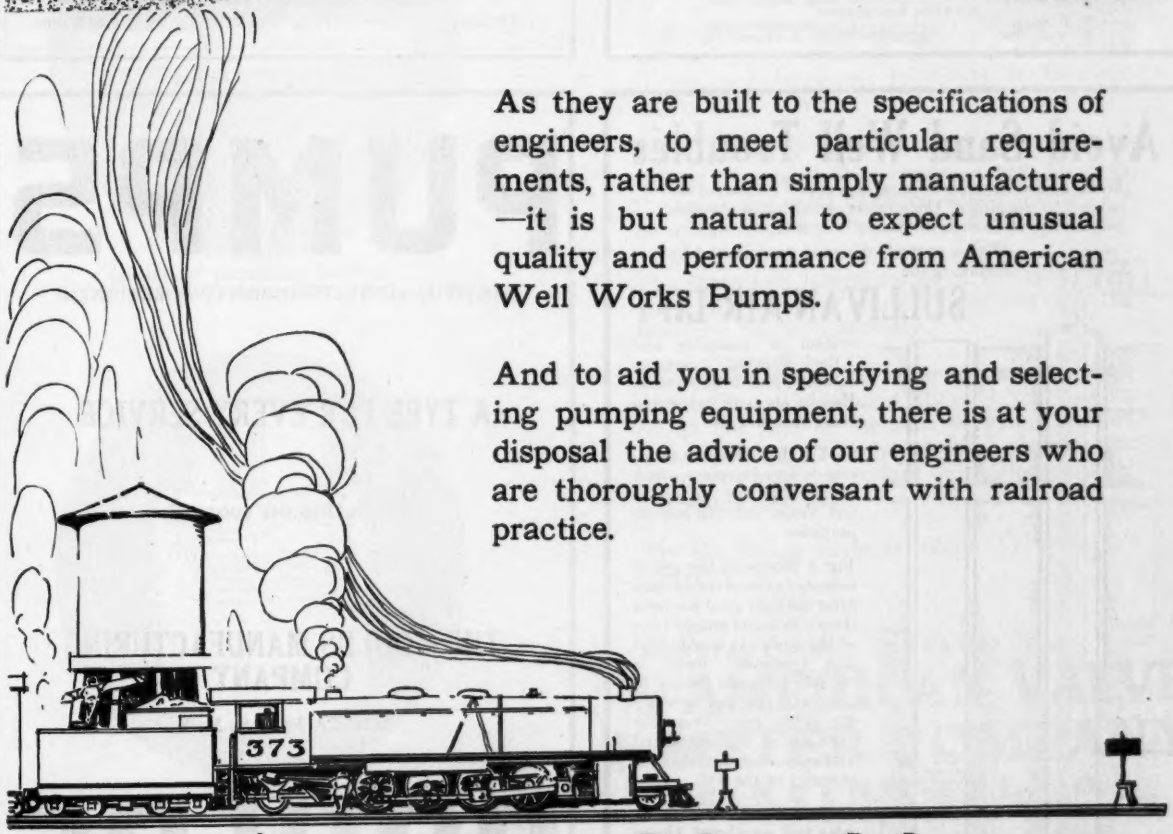

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Railway Maintenance Engineer

Vol. 18 August, 1922 Number 8

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What the stress is in a track bolt?
How ties should be spotted for renewal?
How gasoline should be distributed?
The effect of zinc-treated ties on track circuits?

Answers to these and other practical questions will be found elsewhere in this issue

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(With which is incorporated the Engineering and Maintenance of Way Edition of the *Railway Age* and *Railway Engineering and Maintenance of Way.*)

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WE GUARANTEE that of this issue, 7,500 copies were printed; that 6,669 of these copies were mailed to regular paid subscribers, 62 were mailed to advertisers, 30 were mailed to employees and correspondents, and 739 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 56,350, an average of 7,044 copies a month.

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Railway Maintenance Engineer

The Camp Again a Factor

Immediately prior to and during the early part of the war the housing and feeding of floating maintenance forces received a great deal of attention and many roads made marked improvements in the general standard of their camps. During the last two years the general cessation of construction and a large part of the heavy maintenance work has made it unnecessary to maintain many of these camps and little thought has been given to them. .This season the condition is again being reversed to a considerable extent and camps are in demand. It is to be hoped that as these camps are being reopened, they will be maintained to a high standard, for no single factor contributes more to the ability of a road to hire and to hold men than good living quarters and food. While this ability to hold men has not been as important during the recent months of labor surplus as it was in 1918 a contented force of men is an asset at any time.

The Price of Safety

While accidents are to be deplored, they have their values in the lessons they teach. This is true of the derailment of a passenger train on the Louisville & Nashville at a switch left open by a section gang working nearby, as described on another page. It is difficult to understand how eight men trained in track work could walk by a switch in a main track which had been opened by one of their number and then work nearby for a half hour without noticing this condition. It is even more puzzling to account for the foreman's failure to ascertain personally if the switch was closed. Yet an accident occurred because of these conditions as a result of which two persons were killed and sixty-three injured. This accident points to the necessity of continual vigilance in the performance of all work in the vicinity of the tracks for a lapse may have serious consequences.

Get All Your Foremen Together

No single condition confronting the maintenance foreman tends to handicap him more than the isolation which is inherent in his work. He has little opportunity to come in contact with other men similarly employed and to exchange ideas with them. For the same reason it is difficult for the supervisor to give him the attention and instruction which a man in a similar position in other branches of railway service receives. He is forced to depend primarily upon his own initiative and resources. This condition points to the advantages of meetings of these men at intervals. Such meetings afford an opportunity for the supervisor to outline his program of work, to explain new standards, and to bring to the men new ideas which may have come to his attention. The presentation of a paper by one of their number on some timely phase of their work and its discussion cannot fail to be beneficial to all. The idea of holding such meetings is not new—in fact it is almost as old as the railways themselves. For this reason it is surprising that it has not been adopted more generally. In some instances supervisors make it a practice to call their men together at some central point; in others the division engineer arranges for a meeting of all of the men on his territory, while on still other roads, such as the Kansas City Southern and the Delaware & Hudson, the men are brought together at intervals from even larger areas. No single agency will contribute more to uniformity of work and the building up of the morale of maintenance of way foremen than frequent meetings of this character, at which their work forms the topic of discussion. The plan is worthy of the serious consideration of maintenance of way officers at the present time.

Get Ready for Heavy Traffic

From present indications the railways will be called on to handle a traffic which will tax their capacity to the limit within sixty days. Even at the present time they are handling a business within fifteen per cent of the heaviest ever recorded. With the grain season at hand and the end of the coal strike not far removed, it is evident that the demands for transportation will equal and probably exceed all previous records. This traffic will place an added burden on the tracks and structures and increase the wear and tear on them. Facing this condition, it is important that the maintenance force shall concentrate on those duties which will contribute most directly to the improvement of those facilities which will bear the burden of this increased traffic, both to get them up in the best possible condition before the crest comes and also to get as much work done as possible before the maximum interference occurs.

Observe Care In Using Slow Orders

One point in the discussion of the use of slow orders, which is published on another page, deserves special emphasis. It is to the effect that great care must be used in criticizing a subordinate because of his too frequent use of these orders. An unnecessary slow order is to be avoided whenever possible and if installed in error should be removed at the earliest opportunity because of its influence with train operation. However, safety is the prime consideration and if an employee is undecided, he should lean on the side of safety. If his judgment is faulty, this should be pointed out to him carefully and constructively so that he will not repeat the same error, but extreme care should be exercised in doing this to avoid causing him to go so far in the other direction the next time as to introduce a hazard.

Do One Thing At a Time

What are the essentials for success? It is very difficult to discuss this subject without resorting to platitudes and bromides. Industry, energy, loyalty and interest in one's work are requisites so often mentioned that little is gained by referring to them unless this can be done in a way or through circumstances that will serve to drive home some particular lesson. This has been the intent of the series of articles concerning railway executives who developed their skill in directing the work of others while occupying positions of minor rank in the maintenance

of way and engineering departments. The closer contact with these men, brought about by the efforts to present their stories in our columns, has led to one observation which applies with almost equal force to all of the men interviewed. All of these men possess that quality which enables them to receive a caller with a genuine interest in what he has to say, an outward evidence of an ability to keep the mind clear of everything except the problem immediately at hand. While this is an attribute which these men must necessarily have acquired in order to fulfill the severe requirements of the important positions they occupy, it is of equal value in all administrative positions. Every man may well inquire into his own mental make-up to determine whether or not he has this quality well in hand. Are you able to receive a man in your office, or answer the question of a clerk, or listen to the statement of a foreman in a condition of open-mindedness that enables you to convey the impression that you are vitally interested in what you are being told and which will, therefore, enable you to apply yourself effectively to the problems which are thus brought to you? This does not mean that you must give a man more time than you can spare. One should be able to close the interview without giving offense whenever the business is finished, but as long as the conference is in progress there is no substitute for pure, undivided attention to the business at hand.

REAL EFFICIENCY

ANY CHARACTER of work in which the performance is measured by the cost per unit of quantity is open to the introduction of objectionable practices in an effort to obtain low cost records by the performance of an excess amount of work. This explains why section gangs prefer to renew two ties side by side than to make only one tie renewal for each opening in the track. In the case of ditching, it results in placing undue emphasis on a measure of the performance in terms of cubic yards of excavation when the real test it the number of feet of properly completed ditch. Another source of contention arising from the same cause is to be found in the construction of small concrete structures, such as culverts.

Here we find an open controversy between the man who makes the plan and the man who is responsible for the actual work. The one is anxious to keep the volume of concrete as small as possible because he can then claim credit for having developed an economical design; the other wishes to see the volume as large as possible since his responsibility does not relate to the number of yards required, but to the unit cost per yard on the amount of concrete he is required to make in carrying out the work shown on the plans. For the same reason in cases where the work is done by the field man in accordance with plans which he prepares himself, the tendency to increase the yardage unnecessarily is ever present. What this man should keep in mind is the fact that the greatest economy to the railroad company is not a minimum cost per cubic yard of concrete, but a minimum cost for a completed structure which fulfills the requirements as to strength and permanence. It may cost less per cubic yard to build an unreinforced wall three feet thick, but the entire wall may readily cost less if it is heavily reinforced and only eight inches thick, although in this case the cost per cubic yard of concrete may be much higher. The test in the case of all such questions is the entire cost.

WHO WINS?

It is to be expected that honest differences of opinion will arise regarding many subjects of importance. These may be settled by the matching of forces or they may be reconciled through the more peaceable agencies of organized society. In the drafting of the Transportation Act, Congress provided for the creation of the railroad labor board as such an agency to pass on disputes between the railroads and their employees.

There are three parties to every strike: the employer, the employees and the public. In these days of complex industrial life there are few industries in which the public does not have a stake; the more basic the industry, the greater the public's interest. In the railway field this is the fundamental one of self-preservation, for without transportation we must starve.

A strike is expensive to all concerned; it causes the employer large losses through interruption of work, increased operating costs and decreased earnings; the employees lose their wages with the possibility of permanent loss of positions and the privileges earned by years of service; the public suffers through the interrupted movement of its necessities. In other words, all parties lose in a strike.

IF WE WERE PAYING FOR THEM

IT takes nature years to produce a tie which a careless workman can destroy in a few minutes. The railways of North America draw upon our forests for over 100,000,000 ties annually for renewal purposes. The roads spend for these ties over $100,000,000 or more than four times the amount that goes for rails. Including the labor involved in their replacement, nearly one-quarter of the entire expenditure of the maintenance of way department goes for this single item. No other material used in the repair of tracks or structures approaches it in magnitude.

The principal influence leading to the removal of ties is decay. This arises from natural causes, but it is promoted frequently by the acts of the track forces. Few materials of similar value are subjected to as much unnecessary abuse as ties. The conditions surrounding their storage prior to use are frequently conducive to decay. The driving of picks or shovels into them opens channels for the entrance of water into their interior. The promiscuous and unnecessary respiking exerts an equally detrimental effect. These conditions indicate that maintenance forces have not yet developed that degree of trusteeship which will cause them to protect the investment which their railroad has made in ties as if it were their own and lead them to devise ways to secure the maximum possible life from the ties consistent with the maintenance of the tracks to the proper standards.

TRANSLATING MATERIALS INTO DOLLARS

THE efforts which executive officers have been forced to put forth during the last few years and particularly in recent months to hold operating expenses below operating income has forced them to consider the value of a dollar as never before. It is hoped that the necessities of the situation have caused the same lesson to be impressed upon subordinate officers, for as Samuel Rea, president of the Pennsylvania System, points out in a statement on another page, "It is not enough for a railway man to be concerned with economics of rail renewals or track maintenance or even the expeditious

movement of traffic. He must take an interest in the success of the road as a business."

It is unfortunate that maintenance officers have been trained in the past to think primarily in terms of units of material and standards of maintenance without translating these units and standards into dollars. As a result many do not appreciate the amount of money they are spending or the importance of looking for opportunities for savings. It is only when thinking of work in terms of money values that the opportunity for possible economies can be detected. As an instance, it is a fact known to all track supervisors that every time a rail laying gang is required to close up the track to let a train over, the output of the gang is reduced but it was not until a division engineer on a busy double track railway had translated this loss into dollars that he was able to convince his superintendent of the economy of giving him the uninterrupted use of a track during working hours. The same idea applies to other items of maintenance in the bridge and building and water service as well as the track departments.

The first step in the reduction of costs is to determine what these costs are. The time has come when maintenance officers must think of their work in terms of dollars.

GETTING IT DONE YOUR WAY

PRACTICALLY all maintenance men have suffered the discouragement of having their opinions disregarded or overruled where there was no doubt in their minds but what theirs was the better opinion or one that should at least have received more attention than it did. Take the case of the water service foreman or supervisor when the engineering department, or the management working through some other department, persists in a policy or adopts a program of work that is losing money for the company. Those in authority may insist on the installation of machinery or equipment which he knows is poorly adapted to the immediate purpose in view or would operate to the disadvantage of the department in some other way. Perhaps, even cases can be recalled where to the certain knowledge of the man on the ground, an improvement could have been effected by a much more convenient and less expensive method than the method pursued.

So the instances may be recalled where the work was not done as the man on the ground (the man upon whom it would, perhaps, devolve to carry the work forward), suggested or at least thought it should be done. More than this, it occurs very often that the opinions of these men genuinely merit their solicitation by those in charge and that their way is very often the better way after all. The reason, of course, is that, in many cases, the opinion of the man was not considered or his way adopted because he neglected to voice his opinion to the proper parties, at least before it was too late, or for some reasons he did not prove the superiority of his plan. The suggestion is clear. It is that each worker, man or foreman, should voice his opinion at the right time and suggest a better way of doing a thing when he thinks there is one. This practice, to be sure, will necessitate a closer study of conditions and more careful thought than some men perhaps, have been in the habit of giving, but no one, surely, will doubt the wisdom of this plan. It is manifestly to the advantage of the company to have the benefit of careful thought and practical suggestions of every employee while the man himself, by closer observation, comes to see his work in a new and more interesting light and, above all, is bound in many cases to experience the satisfaction of getting the thing done his way.

Letters to the Editor

THE LENGTH OF THE CLAW BAR

Monongahela, City, Pa.

TO THE EDITOR:

A writer in the March number of the *Railway Maintenance Engineer* recommended shortening the length of the claw bar from 5 ft. to 4½ ft., primarily to avoid short circuiting track and throwing signals, whenever the bar would happen to be dropped onto the opposite rail. There are so many advantages of the longer bar, whereas the occurrence referred to in the original letter is so rare that I cannot agree with the writer's proposal. In a large majority of times when the bar is dropped it will slip clear off one rail before striking the other, so that the experience of fouling signals in this manner will not come to many foremen once in a lifetime. It may certainly be dismissed as a negligible factor in the design of the tool in question, for with wide tie plates even a 4½-ft. claw bar could be made to short circuit both rails and yet who would recommend reducing the length to less than this dimension?

In contrast I would call the attention of the writer to the advantages of the longer bar. First of all it provides greater leverage. Then again it enables two men to use it, as is often necessary. A third point in its favor is that with a short bar, a spike head suddenly broken off might fly back and injure the man much more seriously than would be the case if he were standing farther back as at the end of the longer bar. A fourth advantage arises in connection with other kinds of work. While the writer does not recommend abusing claw bars by employing them for lining track, pinching, etc., such practice nevertheless often becomes necessary and here the longer bar is more efficient.

CHARLES WEISS.

Weeds

ALL THINGS have a purpose. Even weeds may shelter toads, rabbits, and other small life, but when devoted to this good purpose they would not, according to our philosophy, be plain weeds. But a patch of weeds, especially the tall kind, may harbor rattlesnakes, and when they grow up high near a highway and railroad crossing so as to obscure a driver's view of an approaching train, they are just plain weeds and nothing else. They are beginning to grow now, and we should share some of the farmer's anxiety in keeping them down throughout the long summer just ahead of us. Let us keep the highways clear of them near crossings.—*The Safety Message, D. & R. G. W.*

AUTOMATIC TRAIN CONTROL—Following the order of the Interstate Commerce Commission to install automatic train control systems over designated sections of its lines, the Pennsylvania has arranged for the installation of such a system on 45 miles of single track and five miles of double track between Lewistown, Pa., and Sunbury, and is applying speed control apparatus to eight freight and four passenger locomotives in contemplation of the installation of the system and its operation before fall. The system requires that a signal be transmitted to a train to permit it to proceed, while the non-receipt of a signal results in the stopping of the train automatically. A switch opened ahead of a train or of another train backing into a block will cause the apparatus to be applied immediately and the system will provide against excessive and dangerous speed without relieving the engineman of responsibility.

The Use and The Abuse of Slow Orders

Close Co-operation Between Operating and Maintenance Departments Necessary To Secure Desired Results

By W. C. Barrett
Trainmaster, Lehigh Valley, Sayre, Pa.

ANY DISCUSSION of slow orders, to be of any value, presupposes the closest possible co-operation between the two departments involved—the maintenance of way and the transportation. While this article is not intended to be a discussion of organization, it is pertinent to remark here that if the organization is of such a character that the superintendent of the division has jurisdiction over both departments, this co-operation can be secured more easily.

Slow orders are issued primarily for one of two purposes—safety or economy. The largest percentage by far are issued for safety; perhaps too small a percentage for economy.

Safety slow orders may be subdivided into two classes: (1) Emergency orders, put out quickly on account of some unforeseen occurrence, accident, act of God or otherwise, causing damage or obstruction to tracks or structures; and (2) precautionary orders, put out on account of some condition known to exist and which cannot, or will not, be remedied immediately and which, in the judgment of some foreman or supervisory officer, renders the track or structure unsafe for passage of trains at the usual speeds.

The proper use of emergency slow orders involves not only the determination of what is or is not a safe condition of track or structure for the passage of trains at usual speeds, but also the problem as to who shall be authorized to decide this question. Where track walkers or watchmen are employed, they are charged with this responsibility. If, by reason of derailment or accident to trains, operation on other tracks is endangered, the members of the train crew are expected to notify the dispatcher so that the necessary slow orders can be issued. Section foremen are charged with the responsibility for placing slow orders on their respective sections where track conditions, either emergency or otherwise, require the reduction of speed, until the condition can be corrected. Such foremen are presumed to have sufficient judgment to be able to determine when a condition is unsafe and the reduction in speed necessary. Safety being the first requisite in train operation, the man on the ground, whether he be watchman, track walker, foreman, trainman, conductor or whoever he may be, should thoroughly understand that he is expected to exercise sufficient judgment to properly protect train movement, by placing emergency slow order if necessary.

The supervisory officers have the greater responsibility so far as slow orders and safety are concerned in that the organization and training of their forces rests with them, and the manner in which these forces function in emergencies is a sure index of the efficiency and character of the organization. If the supervisory officers have properly trained their subordinates to assume responsibility and to take the initiative in emergencies, they have gone a long way toward insuring safety in the operation of trains. And the judgment of employees, whether supervisory or subordinate, increases with use, so that the placing of slow orders, which must of necessity be left many times to subordinate employees, will reflect the extent to which such employees have been trained to exercise judgment in this respect. Errors will be made, of course—slow orders will be placed which might have been avoided—but it is better for several errors to be made on the side of safety than one on the side of danger. So I would have supervisory officers be careful in their criticism of subordinates in the matter of placing slow orders; show the employee where he was wrong, if he was, but in the right way, so that his judgment will be keener next time, and he will gladly assume responsibility again.

The abuse of safety slow orders can only occur when there is carelessness in the removal of such orders after the necessity has ceased to exist. This matter rests entirely with the supervisory officer in direct charge of the work of correcting the condition requiring the order. He must be thoroughly impressed with the importance of quick action in this regard. The stopping or slowing up of a single train unnecessarily is an economic waste, which is inexcusable.

And here enters the factor of close co-operation between the maintenance of way and the transportation departments. The division engineer or chief maintenance officer on the division should have immediate notice of all slow orders placed on his division, and the supervisor in direct charge of the track or structure involved should certainly know if a slow order is out on his territory and should be held strictly responsible for the removal of the order at the earliest possible moment.

Emergency slow orders are issued by the dispatcher, who gets his information either by telephone or telegraph. The order is either a message or in the form of a 19 train order to all trains using the tracks involved. Where telephone train dispatching circuits are in use, with telephones located at passing sidings and other strategic points, quicker action can be secured in emergencies, as the man on the ground can communicate directly with the dispatcher without the intervention of an operator. This may be a good argument for telephone train dispatching.

Each dispatcher at the end of his period of duty should make a report to the superintendent and chief dispatcher, with copies to all concerned, including the division engineer, of all irregularities occurring while he was on duty. This report will give the chief maintenance officer first hand information as to slow orders, or other track or structure condition affecting train movement, so that immediate remedial action can be taken.

Precautionary slow orders involve not only safety, but, in a rather interesting and complicated way, economy also, for precautionary slow orders are often traceable to lack of sufficient money to spend on tracks or structures to keep them in proper shape at all times for schedule speed of trains. It is true that lack of foresight, inefficiency or carelessness of foremen is sometimes the cause, and sinks

or slides may also be contributing causes; but the primary cause is usually farther away, at the source of the supply of material and labor. In my judgment, the most interesting and complicated, and at the same time the most vital, problem for every maintenance of way officer is the question of how *good* he should keep his tracks and structures—how much money it is economy for him to spend in order to facilitate transportation by permitting heavier loads and higher speeds over the lines, and at the same time avoid slow orders.

Slow speed and slow orders undoubtedly cost money; just how much depends upon many factors—character of traffic, density of traffic, character of line, curves, grades, etc. Railway economists have spent much time and labor calculating this, until it is a fairly exact science; but it is not my purpose to discuss these figures here. The point I wish to make is that economy does not always lie in the direction of a reduction of expenditures on tracks or structures, when such reduction will inevitably result in poor conditions and consequent slow orders.

Slow orders issued for economy are, I fear, conspicuous by their absence on many roads. By economy slow orders I mean orders issued restricting the movement of trains, either by reduction of speed or diverting to another track, or for detouring purposes, in order to facilitate maintenance or construction work on tracks or structures, when such orders would not be absolutely essential for safety. There is ever present with operating officers the temptation to pay attention only to those expense figures which are quickly available and easily analyzed. Transportation expense figures are in this class—and to look only at the total expenditures in other departments where the details are more complicated and the cost per unit not so easily calculated. Maintenance of way expense figures are in the latter class.

The maintenance of way department usually works on an allotment, monthly and yearly, and the only figure easily seen and checked is the total, and so long as this is not exceeded peace reigns and no questions asked. But dollars needlessly spent by the maintenance of way department, because of lack of co-operation and assistance from the transportation department, are dollars just the same.

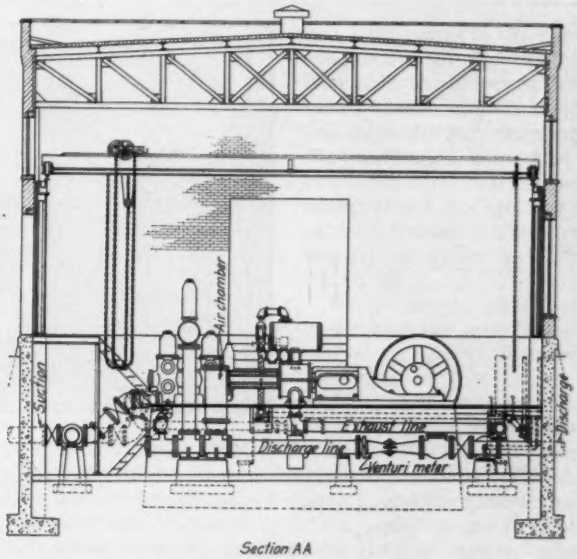
It is true, as we have said before, that it costs money to even slow up trains and more money to stop them; but at the present prices for labor it also costs money to lay rail, to renew ties and to ballast track, and if half the time of the men is lost account interference of trains, the labor cost is certainly doubled. The fullest possible co-operation between the two departments, backed up by the approval of the chief operating officers, may accomplish much in the way of actual reduction in operating costs.

If I may be permitted to mention our own road, I unhesitatingly say that we are proud of the record made by the Lehigh Valley along this very line. Co-operation of the very best sort all along the line has shown remarkable results. Our rail laying costs were so much below those of our neighbors as to cause the Railroad Administration to make a special inquiry to see if the figures were really accurate. And they found that they were. The increased cost of transportation has been so small as to be negligible, and the esprit de corps in the maintenance of way department built up by such co-operative methods has a value beyond computation.

So I say, we will always have the Emergency Slow Order with us; use it with discretion but ever for safety; abuse it not by forgetting its existence, or allow it to grow hoary with age. We may have the precautionary slow order with us if we are careless or indifferent, or if we are too jealous of our means; we may banish it if we will. The economic slow order, welcome it to your road; cultivate its acquaintance and be the richer thereby.

A Large Pumping Station Operated by One Man

TO MEET the needs of growing coal traffic on its Cumberland division, the Louisville & Nashville was recently required to provide a new water supply for its engine terminal at Corbin, Ky. The new water supply is obtained at Dortha, Ky., 3¼ miles from Corbin, where an impounding reservoir was provided by the construction of a dam across the Laurel river, the water being pumped to Corbin through a 14-in. cast iron pipe line.



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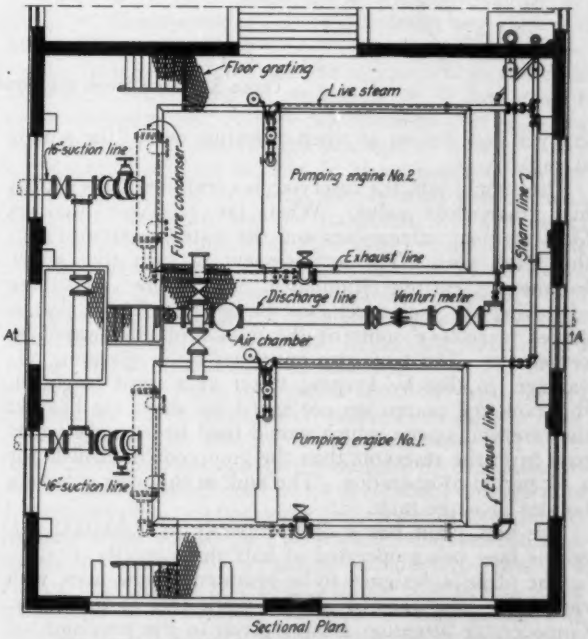


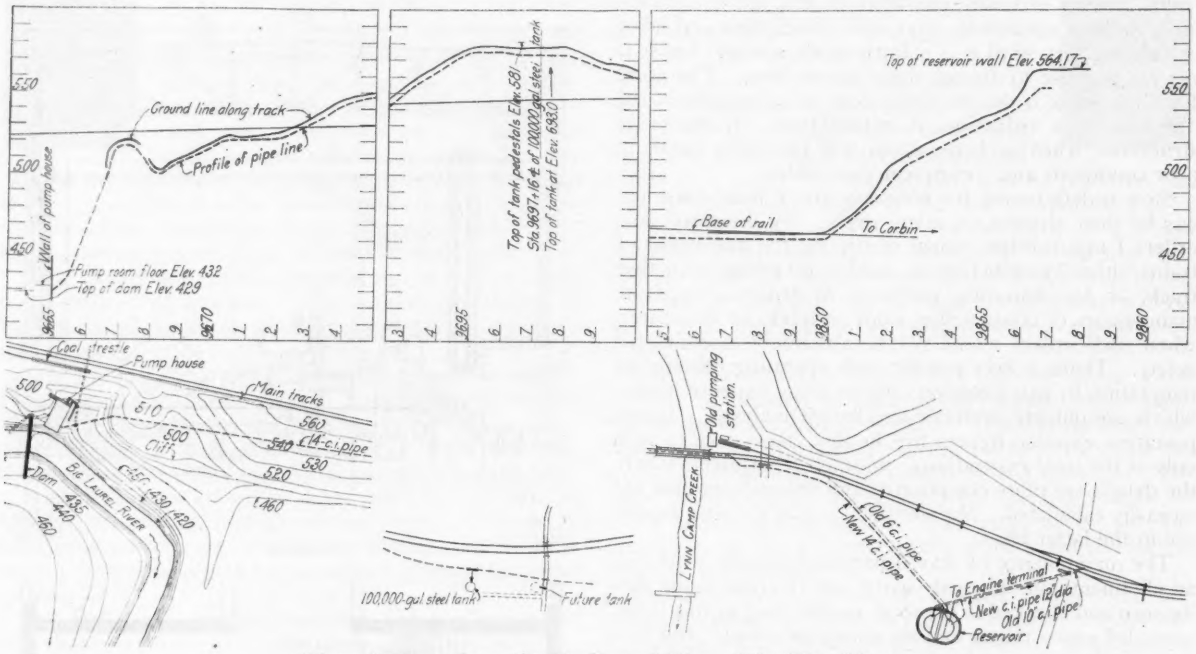
Sectional Plan.

The Plant Is Designed for One-Man Operation

The new water supply embodies the use of an existing 500,000-gal. reservoir located at the top of a hill at Corbin, from which a gravity flow is afforded to the various service outlets in the terminal. As shown in the map and profile, there are two pipe lines from the storage reservoir to the terminal, one of 10-in. and the other of 12-in. diameter.

For the purpose of supplementing the storage reservoir, a 100,000-gal. tank was constructed on high ground about 3,000 ft. from the pumping plant. This tank has its top 128 ft. higher than the top of the reservoir, or 250 ft. above the level of the water in the impounding reservoir in the Laurel river. This tank was introduced into the water supply line to provide a gravity supply from the tank to the reservoir so that when pumping is stopped water will flow by gravity from the tank to the reservoir as long as there is water in the steel tank. The head is sufficient so that the flow through the pipe from which the coal is dumped from the cars into a coal hopper and then chuted down the hillside directly to the floor of the boiler room.

The water is pumped by two 20-in. by 32-in. by 10¾-in. by 24-in. crank and fly wheel pumping engines with Meyer valve gears and rolling mill frame. Each engine has daily capacity of 2,500,000 gal. of water. Only one is operated at one time, the other being held in reserve. The machines are alternated in service daily. These pumps are provided with water relief valves, high-grade pump valves and compound steam governors to regulate



Three Sections from the Profile and Map of the Pipe Line

line will be the same as when operating one of the pumps at capacity.

The supply into the reservoir is controlled by a special high-grade float valve. When the reservoir becomes filled the float valve closes and the water is pumped into the steel tank. The arrangement is such that water hammer is entirely eliminated. A further advantage of having the high steel tank in the pipe line is that it serves to remove some of the mud from the water by settlement. The tank also furnishes some operating advantage, in that by keeping water at a fixed height in this tank the pumps do not speed up when the float in the reservoir opens, which would tend to let more water pass in to the reservoir than the pump could furnish for a set period of operation. The tank in this way acts as a booster or surge tank.

The new plant has a daily capacity of 2,500,000 gal. and is now being operated at half this capacity.

The plant is designed to be operated by one man, who can easily take care of all the work that is necessary. Considerable attention is also given to the provision of simplicity and economy of operation and maintenance.

The country at the site of the pumping plant and dam is decidedly rough, as indicated by the contour lines on the map. To insure a minimum suction lift, the pump house has been placed with its floor level as low as possible with respect to the elevation of the dam. Advantage has been taken of the topography in providing gravity delivery of the coal to the boilers. A coal trestle spur track has been provided alongside the main tracks the machines for over-pressure and under-pressure. Between the pumps in the pump room there is a Venturi water meter equipped to indicate, record and total the water pumped.

Steam is generated by a battery of three 80-hp. horizontal tubular boilers operated at 150 lb. pressure. Two boilers are used at one time to operate one pump. Feed water is fed to the boilers by means of two 5¼-in. by 3½-in. by 5-in. duplex, direct acting boiler feed pumps. Feed water for the boilers is maintained by operating one feed pump. The second is held in reserve and the pumps are alternated in service daily. The feed pumps draw hot water from an open type feed water heater, the make-up water being drawn from the pump main and heated with exhaust steam from the main pumps. Each boiler is equipped with an injector so that cold water may be used in case the hot water supply is disabled. The boilers are equipped with hand-operated stokers and steam soot blowers. Each boiler is also supplied with a differential draft gage to aid the operator to adjust the load properly between the two boilers in operation.

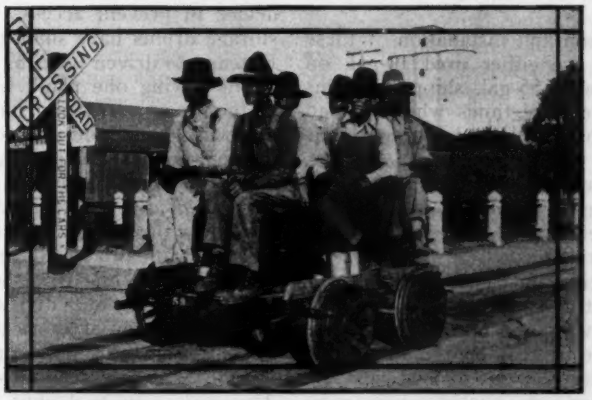
Electric lighting for the plant is furnished by a 2-kw. 110-volt d.c. steam engine generator outfit. The new pumping plant was designed and constructed by the engineering department of the Louisville & Nashville. Railroad.

We are indebted for this information to W. C. Rudd, assistant engineer, water supply, Louisville & Nashville, Louisville, Ky.

How the Missouri Pacific Distributes Gasoline*

Underground Storage Drums Supplied by Tank Cars Reduce Losses to the Minimum: Fuel and Lubricating Oils Mixed

By L. V. Hyatt
Inspector of Stores, Missouri Pacific.



POSSIBLY the consumption of no one commodity used by the railroads has increased so much and advanced in price so rapidly in the last decade as gasoline. With its uses greatly extended, with its consumption multiplied a thousand fold, with the old prices quadrupled, the storage, distribution and accounting for this commodity becomes a subject well worth the serious consideration by those who carry the responsibility of the economical and accurate handling of railroad material and supplies. The stores department of the Missouri Pacific has given this commodity special study, and without having much in the way of precedent, we feel that we have worked out some satisfactory and economical methods and practices during the last ten years, especially in the storage, distribution and facilities for economical handling.

Ten years ago, we had gasoline storage capacity averaging from 1,500 to 9,000 gal. at each of our 16 different division stores. Today we have consolidated this storage at 4 central points and installed batteries of tanks giving any one of these central distributing stores a storage capacity of from 20,000 to 30,000 gal. from which gasoline is distributed to 16 operating divisions; 9 by supply tank cars, and 7 by drum shipments. Four of our supply car outfits include with their equipment one 10,000 gasoline tank car, which we constructed specially with reinforced frame and trucks, to avoid as far as we could the possibility of the car becoming bad order, and getting tied up on the divisions, thus breaking our supply car schedule.

Each of these gasoline supply cars has a steel housing built and riveted to one end of the tank (3 ft. deep, 3 ft. 4 in. wide and 7 ft. high) which protects and incloses a five-gallon measuring pump. This housing serves the double purpose of protecting the pump and its operator from the elements and from mechanical injury and also prevents tampering by unauthorized persons when the attendant is absent. It is quite important that this steel housing and the pump be built and joined integral to the steel tank, so that a shock such as would cause the tank to shift on the trucks and frame will not damage either the pump, the housing or piping.

We also have built a boxed trough along the full length of each side of the tank car, in which is kept a 50-ft. steel armored 1½-in. gasoline hose. One end of each of the two hose is connected to a pipe line which extends from the pump to the running board of the car on each side, the object of this arrangement being to avoid the necessity of dragging the hose back and forth between the cars, to serve the underground storage tanks at tool houses which are located on either side of the track.

When supply cars are spotted at the tool house, one of the supply car men ascertains the contents remaining in the storage tank with a special measuring stick, so as to avoid running the tank over, as the majority of the requisitions filled by supply cars are made out from 20 to 30 days in advance of delivery, and the quantity of gasoline ordered is more or less a guess on the part of the section foreman, censored by the roadmaster, who has the advantage of knowing the average quantity ordered by all his sections and should detect any abnormal order.

The quantity ordered on the requisition is governed by what is considered full protection for 30 days at each given storage point. In very few instances is it necessary to completely fill the 120-gal. storage. On some roads the quantity of gasoline put in these roadway storage drums for a 30, 45 or 60-day supply rests entirely with the supply car man and his judgment, which in some cases is aided by providing him with a blue print table showing the average monthly mileage made by the motor car or cars obtaining fuel from each storage tank, and the maximum quantity of gasoline required; the print also showing the number of oil lights operated on each section and an illuminating oil schedule.

Eight or ten years ago, when the first great strides were beginning to be made on railroads to replace man-driven power with gasoline-driven power, the first problem confronting the stores department of the Missouri Pacific was to design and adopt a standard storage tank for roadway use. After some time spent in experimenting and study we adopted an underground storage tank which has since proved entirely satisfactory—this is a 120-gal. corrugated No. 18 galvanized iron drum, which we specify to be painted with rust-resisting paint. The capacity of 120 gal. was chosen in order to insure sufficient storage at a time when gasoline was being shipped out in 55 or 110-gal. lots, giving a little storage leeway to avoid holding the shipping drum. The corrugated style was adopted not only to give strength but also to have a drum that would stay buried, as we found that water would force smooth-sided tanks out of the ground in the swamp districts of the South.

These drums are buried at the end of the section tool house, usually about 15 or 20 ft. from the track, which

*From a report presented before the annual meeting of the Purchases and Stores division of the American Railway Association at Atlantic City on June 19-21.

is in easy range of our filling hose. They are set vertical and from 6 to 10 in. below the surface, a 2½-in. nipple with chained cap extending above the surface, from which gasoline is drawn by a tin gasoline pump, which is kept locked up in the tool house. This pump is manufactured by the store department, and its construction is not only simple but durable. We consider that this complete outfit makes an economical method of handling gasoline for sections and pumping stations. Bridge and building outfits, or in fact any units of our forces which move from point to point, carry these same storage drums on their open outfit cars. We have 846 of these drums in service on our lines, or 120-gal. gasoline storage for every 9 miles of railroad.

Prior to the general adoption and installation of these underground storage drums, we either used 10-gal. oil cans, or held the oil companies' 55-gal. shipping drums to answer as storage. There were times when we had as high as 2,000 drums on our lines, and the enormous volume of clerical work in recording their movement, length of time held, and tracing and obtaining the final return to the owners or paying for drums we lost, entailed an expense which has been eliminated so far as gasoline is concerned, on the Missouri Pacific.

The Santa Fe, Union Pacific and several other roads have found it both expedient and economical to reclaim a variety of old drums, reservoirs and miscellaneous containers, which after being tested for leaks and painted with a good coat of preservative paint against rust are distributed as roadway storage with varied capacities at different locations. One source from which they obtained a great many gasoline storage receptacles was by making use of the Pintsch gas reservoirs which were removed from their passenger equipment at the time electric lighting was installed, these gas drums being cut in two in the center, cleaned of all sediment and incrustations and each half made into a drum by being headed and provided with a uniform hole for the filling and withdrawal of gasoline.

One of 10,000 gal. gasoline supply tanks serves 4 divisions having 220 storage drums. To take care of this same territory by drum shipments would require at least 300 of the standard commercial 55-gal. drums. Considering that the average life of one of these shipping drums cannot be figured as over four or five years, and their cost from $5.50 to $10 each, and also figuring the loss and damage in transit, it is reasonable to assume that the circulation of one large tank car is more economical than the handling and circulation of 300 shipping drums.

At our main store points where we have our battery of gasoline storage tanks, we have installed small reciprocating transfer pumps which operate either by air or steam pressure, according to which is the most handy; these pumps transfer gasoline into our storage from line tanks, or from our storage to the supply tank cars, quickly and economically.

The labor cost of filling a large line tank car by use of these transfer pumps at headquarters is practically nothing, while the unloading, filling and reloading of 10,000 gal. of gasoline in separate 55-gal. shipping drums will cost close to ten cents for each drum handled (based on actual test), even with the best facilities.

To control the issuance and consumption of gasoline on the Missouri Pacific we are following the matter up on all divisions by requiring all section and extra gang foremen to furnish their superintendents with monthly reports on which they show the total number of miles they have run their motor cars during the month and the total gallons of gasoline they have used, as well as the amount of lubricant. This report also shows how much if any of their stock of gasoline was furnished to itinerant motor cars so that proper charge can be made through the superintendent's material distribution. Officers or other employees taking this gasoline have instructions to leave a note in the section tool house advising the amount of gasoline taken, or else tell the foreman along the road when they meet him. Some of our superintendents have also requested and are procuring from our storekeepers a monthly statement giving our record of the gasoline which our supply cars furnish each of his section and bridge and building foremen.

There are many effective methods to discourage or avoid theft. Practically all of our storage drums that are located along the line or in isolated places have some device to prevent access. Many of the underground storage drums have small platforms built on the surface fastened to driven posts to make them secure, these platforms having one plank hinged, and being kept locked by the use of a hasp and staple. Another effective method of locking an underground tank is to have a slot cut through the gas pipe leading to the drum. Then by using a flat tee-shaped iron slide with a hole in one end for a padlock, it can be locked against the insertion of either a hose or pump. However, the design of our standard storage outfit practically precludes the use of any pump other than the one furnished with the equipment.

On some of our divisions the gasoline is doctored by the addition of lubricating oil at the time it is delivered from the supply cars. One pint of oil to sixteen pints of gasoline seems to be the most generally used. This makes the fuel unfit for anything but the roadway types of motor cars. A person might try this mixture in his automobile once, but never again.

Open Switch Causes Wreck

THE BUREAU of Safety of the Interstate Commerce Commission has just issued a report on the derailment of a passenger train on the Louisville & Nashville at Hilberta, Ala., on June 15, which resulted in the death of 2 persons and the injury of 63. This derailment occurred at a switch which had been opened and left in that position by members of a section gang which was working in the vicinity. About one-half hour before the accident occurred the section foreman instructed one of the eight laborers in his gang to open this switch to enable the section motor car and a loaded push car to be backed in on the siding. The foreman then got off the motor car and instructed his men to procure shovels from the push car and begin work on the main track a short distance ahead of the switch. Although it was necessary for these men to pass this switch on their way to the work none of them noticed the position of the switch points or the indication of the switch target, either at the time they passed or while the work was in progress. Also while the rules required the section foreman to ascertain that the switch was properly closed after the motor car and push car had entered the siding, he admitted that he did not do this, although he went back to examine the frog and while there was handed the switch key by the laborer, who apparently had forgotten to close the switch.

On account of the dust raised by the section crew in working on the track, the engineer of the passenger train was unable to see the indication of the target until within 150 ft. of the switch, when he shut off steam and applied the air brakes in emergency, at which time he estimated that the speed of his train was between 50 and 55 miles per hour. The engine was overturned and five of the ten cars were derailed, but remained upright. Those killed and three of the injured were employees of a produce company working in a warehouse along the siding. The track forces were experienced men.

Take An Interest in the Success of Your Road as a Business

In the Opinion of President Rea, of the Pennsylvania, This Is One Essential for Progress as a Railroad Man

BY WALTER S. LACHER

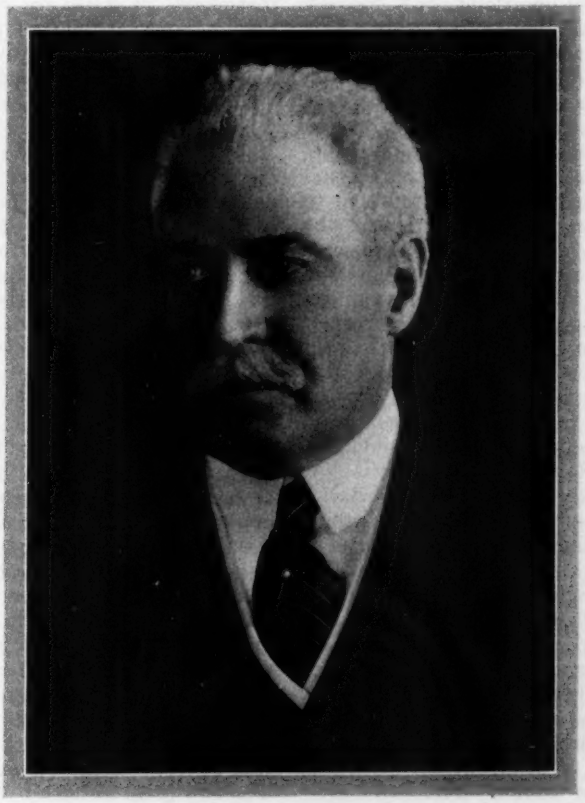
A YEAR or two ago a young track supervisor on the Pennsylvania was offered a position outside of railroad work at a considerable increase in salary, but he declined it.

"In the Pennsylvania organization," he said, "every supervisor has a clear line of promotion ahead of him. Nearly all of us are engineers, and on our road technical training is considered almost an essential for advancement. Samuel Rea, our president, and five of his predecessors were engineers, so I feel that I have a real opportunity and I want to make the most of it."

These were not the words of one who curried favor by "talking to the gallery." In fact, this particular instance never came to the notice of Mr. Rea or any other officer of the Pennsylvania until it was set down here. While perhaps few men have ever expressed themselves as frankly as this supervisor did, nevertheless, his statement is truly representative of the spirit that is bred into the Pennsylvania organization. It is, in fact, particularly characteristic of the maintenance of way department because of the many graduates from this work who are numbered among the general officers.

In view of this it seemed appropriate to ask the head of this great railroad, with its 220,000 employees, just how the system of promotion was carried out, but while Mr. Rea is an engineer, he was never a maintenance of way man, and he did not seem at all inclined to the opinion that the maintenance of way department received a special preference in promotions.

"I don't feel that it is exactly correct to say that we have a definite line of promotion. What that will be for each individual depends very largely on what he makes it. Of course, the maintenance of way officers on our road have a certain advantage in the fact that most of them have received a technical training that would help them in any organization, and this is broadened by resident service on various divisions, yards and terminal headquarters, which keeps them close to the tracks and structures and the traffic moved thereover and to the localities in which business is obtained or delivered."



Samuel Rea
President, Pennsylvania System

Mr. Rea recently voiced his opinion more in detail on this same matter.

"There is no education in the world superior to that obtained by actual contact with the world in the struggle for bread and butter and position. Whatever may be said of those who have attained important and responsible positions in the past by having that practical education which comes from hard work in the day, and from that self-denial which places education above recreation through intense study at nights and in the holiday season, there can be no doubt now of the advantage to the young man who begins his work with an intensively trained mind. Other things being equal, with health, common sense and reliable character, added to education, he will go ahead faster and get farther than the man who lacks that great initial advantage. Indeed, in the technical branches of railroading, as well as mining and most of the productive industries, we have reached the point where the preliminary training of a college or a university course is no longer looked upon merely as an advantage, but has become, practically speaking, a necessity for the young man who aims at a place in the executive forces."

This conclusion is of particular interest as coming from Mr. Rea, because he himself entered railway service at an age that made a college education impossible.

"Conditions were different when I entered railway service," he explained, "there were very few college men then, while today there are many in railroad work."

It may be that what he lacked in technical training was made up by an abundance of inspiration. There is a certain coincidence in his birth at Hollidaysburg, Pa., in September, 1855, less than 10 miles from the famous horseshoe curve over which trains of the Pennsylvania were run for the first time only 18 months before, thus completing the first all-rail connection between Philadelphia and Pittsburgh. Up to that time Hollidaysburg, at the foot of the eastern slope of the Allegheny mountains, had been an important place on the canal route between those two cities, because it was there that the transfer

was made from canal to the Portage railroad extending over the mountains to Johnstown. But the new form of transportation soon superseded the canal and it is not surprising that the railroad appealed to the boy at Hollidaysburg and made him long for a chance to become associated with it.

This opportunity came in his sixteenth year when the Pennsylvania undertook the construction of the Morrison Cove branch, a line extending into the mountains a short distance east of his home. He succeeded in obtaining a place in the survey party as a chainman, and later served as rodman. But railway engineering then, as now, had its interruptions with the varying fortunes of the country and with the advent of the panic of 1873 young Rea found himself out of a job. During the next six years he had a rather varied experience, partly of necessity born of the temporary nature of the work in which he was engaged and partly, no doubt, from a desire to get a broad experience by contact with human nature as well as business or from a certain degree of uncertainty as to the best course to pursue. Early in 1874 he secured a place as a clerk with the Hollidaysburg Iron & Nail Company, which he held until the spring of 1875, when he again joined the Pennsylvania organization at Connellsville, Pa. He left this position in the summer of that year to serve as assistant engineer on the construction of the "Point" bridge over the Monongahela river at Pittsburgh and when this work was completed in 1877 he returned to railroad work on the location and construction of the Pittsburgh & Lake Erie. When this road was opened the country was again suffering from depression and all engineering work stopped, so he continued his connection with the P. & L. E. not as an engineer but as cashier in the freight office at Pittsburgh.

It was after his return to the Pennsylvania in 1879 that Mr. Rea was afforded an opportunity to become more permanently identified with the property. He was placed in charge of surveys in connection with the rebuilding of the Western Pennsylvania Railroad to make it a low grade freight line, under the direction of J. N. DuBarry, then assistant to the president in charge of promotion and construction of feeding lines. Mr. DuBarry was so much impressed with the work done by his assistant that when he was made vice-president in 1883 he arranged to have Mr. Rea transferred to Philadelphia as his assistant with the title of principal assistant engineer.

In the story of the engineer who has been advanced to executive positions in the railway field, we usually come to the point where his ability as an executive is recognized in his selection for an operating position. But not all men are afforded the contact with railway operation that puts them in line for such promotion. Mr. Rea's early service with the Pennsylvania was spent largely on construction or special assignments that gave him little direct responsibility in routine maintenance of way and transportation, although it afforded close contact with the officers and men in those departments in the planning and development of the lines of which he was engineer.

However, advancement came to him through the development of a capacity for a greater degree of responsibility for the construction or development work with which he was entrusted. In short, by hard work, travel and observation, he became more than the engineer of the projects to which he was assigned. With increasing authority came the titles of assistant to the vice-president, assistant to the president, and finally, in 1899, vice-president.

As a rule, the province of the engineer is limited to the physical problems of location and construction. Therefore, the question naturally arises as to what a man must do to develop a capacity for dealing with the larger problems of railway expansion—matters usually handled by general officers of broad experience. The answer is of general application.

"A man cannot stand still and if he would avoid going backward he must always advance. This means that he must study all the problems which are concerned in the work in which he is engaged, whether he is directly answerable for them or not. He must constantly broaden his knowledge by study—not only of books but of the people he meets and the things he sees. He must be a keen observer."

Mr. Rea did not use these exact words, but they express definitely the rules which he has applied to himself so consistently that it has become a fixed habit. Mr. Rea not only reads much, but he remembers what he reads. His memory also has helped him to retain a remarkable detailed knowledge of the property, especially within the state of Pennsylvania. But even today the great responsibilities that go with the presidency of a railway system that covers 13 states are no deterrent to the exercise of keen observation. He often utilizes this faculty in riding over the tracks of other roads while on his business trips to observe the practices pursued.

However, he does not concern himself solely with railway affairs. His is the active type of mind that manifests a sincere interest in a wide variety of things. As a result he can speak authoritatively and entertainingly on many subjects. It is said of him that he can hardly get by a news stand without buying a paper. But his general reading goes far beyond the daily press. "Just now," he said, "I am reading the life of Lincoln by Charnwood, the Englishman. His detached point of view makes it extremely interesting."

Mr. Rea's interest in matters beyond the scope of his assigned duties was manifested in 1887 when he made a personal study of the physical and financial conditions of the English railways, as a result of which he wrote the pamphlet, "Railways Terminating in London." No doubt it was because of his thus broadened vision that he was considered the logical man for President Roberts of the Pennsylvania to send to London in 1892 to study the tunnels and underground railways and transit questions. The knowledge gained at that time and his contact with British engineers and railway men obviously was of inestimable value to him when, under the regime of President Cassatt, he was placed in responsible charge of the Pennsylvania's tunnel extension into and through New York City, probably the greatest construction project ever undertaken by any railroad in the world.

The general features of this great undertaking are so well known that more than a brief outline is superfluous. The two great obstacles were the Hudson and East rivers. Efforts to interest other roads in the construction of a bridge being sunsuccessful, recourse was had to the alternative, tunnels through the soft mud under the North or Hudson rivers. This not only entailed the use of untried method of construction, but raised grave questions concerning the ability of the subaqueous materials to sustain the heavy loads of modern railway trains. It also required electric traction, then almost without precedent as applied to steam roads. It was also necessary to excavate subways through solid rock across Manhattan Island and drive four tunnels under the East river to make a connection with the Long Island Railroad. Later plans were made for a 1,000-ft. arch bridge of the New York Connecting Railroad carrying four ballasted tracks across Hell Gate to afford a connection with the New York, New Haven & Hartford in the Bronx.

In all these problems Mr. Rea commanded the services of engineers who were specialists in the various classes of work to be carried out, but this did not relieve him

from the burden of the intricate administrative problems which necessarily arise in any work involving the expenditure of close to 150 million dollars. These included the correlation of the work of his various assistants and the adjustment of their differences, dealings with the owners of the costly real estate required for the site of the great passenger station, and almost endless negotiations with the city and state for the necessary enabling ordinances and statutes.

There were times when the difficulties seemed almost insurmountable, but Mr. Rea seemed to possess a faculty for finding a way out, not through any particular gift of intellect, but through a skill that came from long training in railway expansion. True, these problems had been of smaller scope, but each had taught a lesson that had its application in the larger work.

While the project saw its attainment on August 1, 1910, when the Pennsylvania station was formally opened and the Long Island electrification was completed, the connection with the New Haven via the great Hell Gate structure was not completed until several years after Mr. Rea was placed at the head of Pennsylvania system in 1913. It may be said, therefore, that for 15 years he devoted the major part of his thought and energy to this great achievement.

A railway property representing an investment of two billion dollars which carries one-eighth of the rail business of the country must be well officered. The selection of men to fill many positions of responsibility is no easy task and those who are confronted with it are sure to have some well defined convictions as to requirements.

"One essential for success as a railway man," says Mr. Rea, "is a properly directed interest in the property. It is not enough to be concerned with the economy of rail renewals or track maintenance, or even the expeditious movement of traffic. A man must take an interest in earnings—in the success of the road as a business and in his heart he must be loyal to the company and to the public.

"To be in a frame of mind where he can be of greatest value to the property, a man must approach the problems of railway transportation with a faithfulness to the trust reposed in him by the management and to the patrons of the line and territory it serves. It is only with that viewpoint that he can fully appreciate the problems which now confront the managements of our railroads and he must realize the impossibility of being a successful railroad officer unless he can assure the earning of a fair return in each year and pay fair wages to the employees.

The Control of Expansion*

By J. Turman,
Roadmaster, Kansas City Southern, Hume, Mo.

EXPANSION can be controlled; the extent to which this is possible depends largely upon when you commence the job. My opinion is that the successful control of expansion depends almost entirely on the manner in which the rail is laid. This is the logical time to see that the proper amount of expansion is provided. If this provision is not carefully looked after, it is almost hopeless to correct it later. The nearer the expansion is to the theoretical amount required, the easier it is to handle.

The ideal solution of the problem is to hold each rail in its original position and thus preserve the exact relationship of the rails to each other; in that way preserving the expansion. This can be assisted materially by full-bolting the angle bars and keeping the bolts tight. Subsequent to the laying of rail, bolts should be gone over at least three times at intervals of not to exceed ten days. My experience is that it is impossible to get the bolts and angle bars set on the rail with only one additional tightening of the bolts after the rail is laid. If the bolts are put under too much stress the first time they will be injured.

Where rail is to be anchored, it is important that the application of the anchors be kept up with the rail laying as closely as possible. This becomes particularly important during changeable weather when the temperature at mid-day is considerably higher than at night.

Previous to the application of rail anchors, the ties should be spaced, and the track well surfaced, lined and filled in. This will insure a stable foundation for the rail which, when anchored under these conditions, should show little tendency to creep. Where the expansion is allowed to bunch, it damages the ends of the rails and ruins the bolts and angle bars. This is detrimental to the surface and, what is more important, it is difficult to resurface any track where the expansion is not approximately correct.

Where rail begins to get tight, or in other words, when the expansion is becoming less than is necessary, it is a sure sign that something is wrong. When this is first noticed it is time to go to work on the adjustment of the expansion. Instead of raising a few low joints and doing a little lining, more important work can be accomplished by attending to the expansion. The best tool to use in governing the expansion is the track wrench, if properly used and at the right time.

It is generally known that the rail is more liable to move in the spring when the warm weather first commences than during the extremely hot weather later because by the time the hot weather arrives, the rail has to a large extent, readjusted itself from the contraction of the previous winter. The spring is the time to use the track wrench to readjust expansion. The way to do this is to go along the track in the morning and loosen the bolts when a joint is found that has more than the proper amount of expansion. Later in the day when the rail has become warm, it will close up this loosened joint. When this has been accomplished, tighten the bolt. By careful and consistent work along this line, it is possible to make the rail itself adjust its own expansion allowance. I have found several sags or short dips, where the rail has moved up hill, leaving too much expansion at the bottom of the sag. I believe that this can be run back by being careful to loosen the bolts at the right time and allow the rail to run back from the right direction. When the weather begins to get cool in the early fall, we have another chance to gain control of the expansion, for when the contraction starts, we have the same chance to readjust the expansion as in the spring when it started to run. Where the driving of the rail is necessary, care should be taken to ascertain the proper direction in which to drive it.

Conditions are sometimes allowed to go to the extent that the only rational thing a foreman can do in an emergency is to cut the rail in order to overcome the effect of the creeping and the loss of expansion incurred thereby. This is a bad practice, and it is to the discredit of the foreman whenever this becomes necessary. A foreman who is taught to observe his rail carefully and the way to retain the proper expansion, should never find it necessary to cut a rail. This statement is made on the assumption that the rail was laid properly in the first place and the needed expansion allowed at that time. The creeping of rail is usually a slow process and careful observation, together with attention at the proper time, should be sufficient to eliminate emergency treatment.

*From a paper read before the Maintenance of Way Association of the Kansas City Southern at Sulphur Springs, Ark., on May 13.

A Long Time Record of Pier Movement

Shifting Caused by Sliding Hillside at Bismarck Bridge Is Stopped After 35 Years

By M. F. Clements
Bridge Engineer, Northern Pacific, St. Paul, Minn.

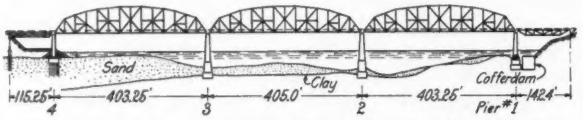
THE NORTHERN Pacific was built into Bismarck, Dakota territory, in 1873 and was constructed west from Mandan in 1880. In 1881 the location of a bridge over the Missouri river was fixed, and the substructure started and in 1882 the bridge was completed. The bridge, as first built, consisted of three 400-ft. through pin-connected whipple truss spans, two 113-ft. deck pin connected spans and 1,500 ft. of timber trestle. The trestle was filled later.

The piers supporting the 400-ft. spans were founded as follows:

Pier I on blue clay 16 ft. below low water. Pier II on blue clay 48 ft. below low water. Pier III on blue clay 47 ft. below low water. Pier IV on pile foundation 6 ft. below low water.

Immediately after the completion of the bridge, the Bismarck waterworks was established. A plumbing plant was built near the river bank, adjacent to the bridge, and a pipe line was placed in a tunnel just east of the approach span and leading to reservoirs placed on the bluff east of the bridge. The reservoirs were completed in 1886.

Pier I was constructed of granite masonry resting on a Portland cement concrete footing. Its base as first constructed was 50 ft. by 24 ft. and 18 ft. thick. The pressure on the base was 5,690 lb. per sq. ft. The excavation was carried down through a hard, dense blue clay for the full depth without the use of a pump, although the bottom of the base was 16 ft. below the water surface.



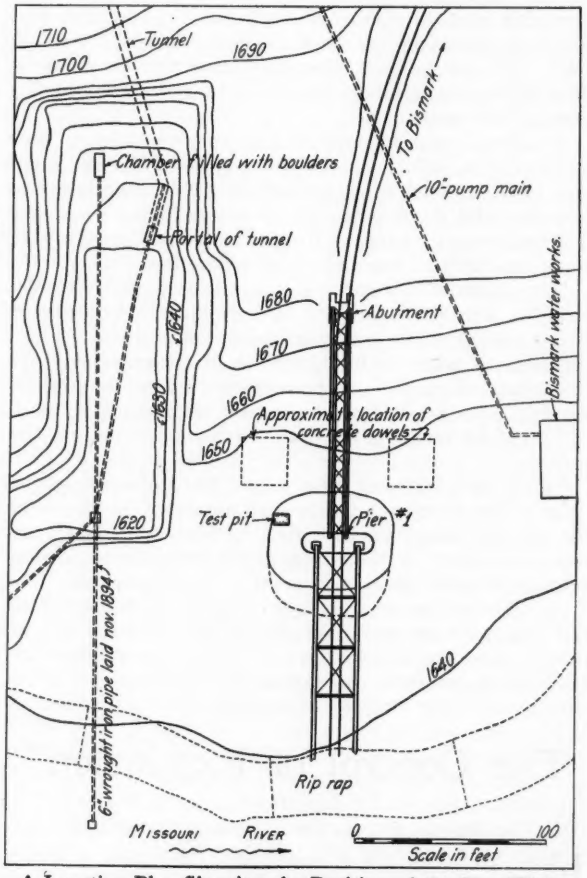
General Elevation of the Bridge Showing the Conditions Since 1917.

Practically from the date of completion of the bridge Pier I has moved intermittently toward the river. There was no settlement in the pier which could be measured and the whole movement was horizontal. A chart shows the total movement of the pier from 1883 to date. From 1883 to 1888 the measurements were not made accurately for individual months or years. From 1888 to 1905 the measurements were made at the ends of trusses with no adjustment for temperature. The record from 1905 to 1910 is incomplete, but in 1910 measurements were taken with a tested tape and the change in method of measuring accounts for the eastward movement recorded on the chart. The expansion rollers for the original east span were on Pier II and wood blocks were inserted between the spans to prevent movement early in the life of the bridge.

The movement of Pier I was gradual from 1883 to 1888, when a very marked increase was noted. In August, 1888, it became necessary to remove the wooden blocks between the spans on Pier II and move the center and easterly spans westward. The east span was moved 17¾ in. at one time and a few weeks later was moved an additional 3 in.

In September, 1888, a frame bent was built on the east side of the pier to carry the approach span, and in August, 1888, the supply pipe between the pump house and reservoir of the Bismarck waterworks pulled apart and the bluff was flooded with water. The movement of the pier became serious that year and an attempt was made to stop it.

It was assumed that the movement occurred on a plane surface at some point below the bottom of the pier and plans for stopping the movement had been based on that assumption. The original soundings located an 18-in. vein of lignite coal about four feet below the base of the pier and it was assumed that the surface of the coal was the plane of sliding.



A Location Plan Showing the Position of the Pier With Respect to its Surroundings.

The plan suggested for stopping the movement of the bluff was to construct large concrete dowels which would extend above and below the plane of sliding and tie the upper mass to the lower. In addition, it was thought best to divide the slide by excavating a cut into the bluff, dividing the north side of the bluff, where the movement was greatest, from the south side. The excavated material, a total of 24,000 cu. yds., was deposited on the river side of Pier I to counteract the movement of the bluff.

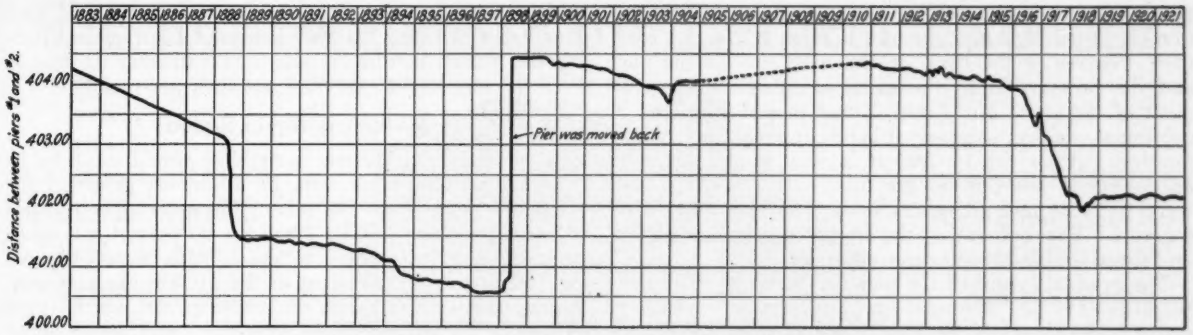


Diagram Indicating the Amount That the Pier Was Moved Back in 1898.

In making the excavation for the concrete dowels, it was reported that directly on top of the coal was a slippery, muddy clay from ½ to 1 in. thick. It was assumed that this substance lubricated the top of the coal so that the overlying material could slide. The dowels were located east of Pier I, 24 ft. and 30 ft. and 25 ft. and 40 ft. on either side of the center line. They are 25 ft. square and contain approximately 400 cu. yd. of concrete each. They were reinforced with railroad rails set vertically in the concrete. The bottom of the dowels were 12 ft. below the bottom of the pier.

At this time, an effort was made to drain the water that collected in the crevices in the bank. On the completion of the work it was found that the pier continued to move, but it was assumed that such movement would stop when the material back of the dowels became thoroughly compressed. The assumption proved to be erroneous and the pier continued to move.

From 1888 to 1895 the movement was gradual. In 1895 it became evident that the leakage of water from the Bismarck waterworks reservoirs on the bluff was causing trouble. A series of tests indicated a leakage of 60,000 gal. daily and test wells showed that the water was collecting in hidden cavities and drains were constructed to carry it to the river. In 1897 three pipes were sunk to determine the plane of sliding and the rate of movement and the pipes broke from the movement below the bottom of the pier. In that year the movement had reached a maximum of 44 in., the approach span was supported on cribbing built up from the ground, and the 400-ft. span was resting on the edge of the bridge seat.

Decide to Move the Pier Back

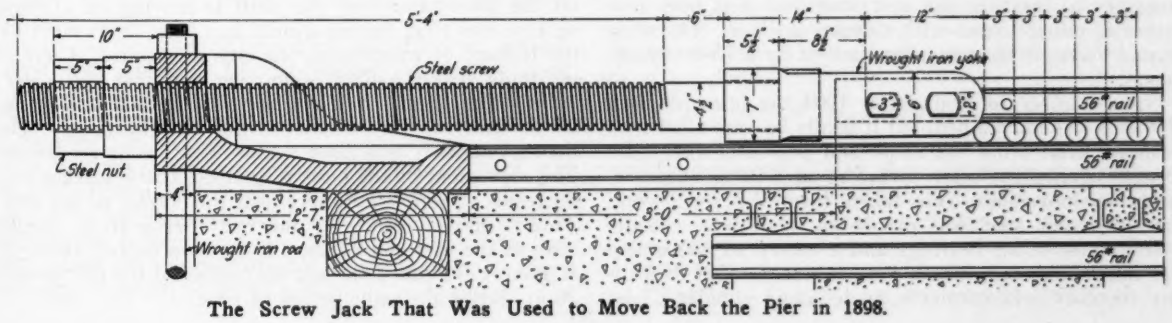
To make the pier serve again as a support for both steel spans and correct a further movement, it was decided to rebuild the pier or place a new footing under the old and move it back to its original position. It was assumed that a pier of greater depth which penetrated the material below the lignite coal would be permanent. Consideration was given to various means of replacing the pier. If the pier was rebuilt, it meant placing both spans adjacent to it on falsework. A plan for moving the pier was adopted and the work was finally completed along those lines.

The material on which the pier was founded consisted of a hard blue clay. Laboratory tests on one-inch cubes, when dry, indicated that it had a compressive strength of 58 lb. per sq. in. when dry. The material was ideal for tunnel operations and the method adopted for excavation beneath the footing of the pier consisted of tunneling.

The tunnels were driven under the pier in the direction the movement was to take place. The openings were 5 ft. 6 in. wide and 13 ft. deep and were 5 ft. apart. The bottom of the pier was smoothed off by stone cutters. Four 56-lb. rails were bolted together and placed in an inverted position under the pier in each section. The excavation in each section was filled with concrete and four 56-lb. rails, bolted together, were placed on the concrete so that the rails top and bottom were separated by 2-in. by 18-in. steel rollers with a clear space of one inch between them. The upper rails were filled with concrete before placing them and they were jacked into position and grouted to the masonry. Considerable difficulty was experienced in getting the rails to bear on all rollers and a maximum variation of 1/32 in. was obtained. Five tunnels were driven in all, each having two sets of rollers, there being a total of 1,020 rollers. When the tunnels were completed, the space between them was excavated and filled with concrete up to a point 2 ft. 6 in. from the bottom of the pier, its weight being transferred to the rollers. One-inch wood blocks were placed between the rollers until the pier was ready for movement.

The movement was effected with the aid of ten screws, 4½ in. in diameter and with a ⅞ in. pitch. One end of these screws was bolted to the upper rails and the other to steel nuts 9½ in. in diameter, on which were fitted cast iron wheels 27 in. in diameter, equipped with sockets for inserting levers.

The first concrete was placed in January 1, 1898, and it was completed on May 29. At the time of moving the pier, the wooden blocks between the rollers were removed and force was applied to the hand wrenches. It



The Screw Jack That Was Used to Move Back the Pier in 1898.

required two minutes to move the pier ¼ in., six minutes to move it 1 in. and nine minutes to move it 2 in. A cave then occurred in the bank on the west side of the pier and the pressure from the earth completed the movement of the pier. In 12 min. it had moved 5 in. and it continued unaided, stopping at approximately the original location. After the movement it was found that 163 rollers, or 16 per cent of the total, were loose. These were removed and all spaces under the pier filled with concrete. The west end of the approach span was placed on rollers so that the pier moved under it.

The original height of the pier was 82½ ft. The new height is 95½ ft. The total load on the rollers was estimated at 8,172,000 lb., or 532 lb. per in. of rollers. The concrete in new footing totaled 840 cu. yd.

The Movement Continued

Although the new pier was of greater depth and penetrated the coal seam, the movement continued. In 1899 it was 3/16 in. and in 1903 it had increased to 9 11/16 in. The excavation around the pier remained open for a time, but it gradually filled up so that the pressure of the moving bluff acted against it. To relieve the pressure, an excavation was again made in 1904, when the pier readjusted itself and moved back 5⅛ in., leaving a total displacement at the top of 4 9/16 in. A test pit sunk at the south end of the pier to the junction of the new and the old footings exposed a crack between them and it was assumed that the footing course had not been moved.

In June, 1903, a test disclosed a leakage of 100 cu. ft. per hour in the water company's reservoirs. The supply pipe to the reservoirs passes under the track east of the bridge in a tunnel. A movement of the bluff caused the pipe to pull apart in September, 1903, and the leakage found its way into cracks in the hillside and a movement of 2½ in. in six weeks was noted.

In the winter of 1903-1904 a drainage system was installed which consisted of two lines of perforated pipe extending from the surface and ending in tunnels built into the bluff. The pipes were to collect the water leaking from the reservoirs and carry it away through a drainage system into the river. The total length of main tunnel was 1,180 ft. and extended from the foot of the bluff on the north side of the track to a point near the reservoir, where it branched off on either side. The tunnel was lined with timber and when first built, the bents were four feet apart, with plank lagging behind. There were originally 180 bents in the main tunnel, 132 in the north branch and 114 in the south branch. In making repairs, intermediate bents were placed and in certain parts they are now together, so that the use of new lagging is not required.

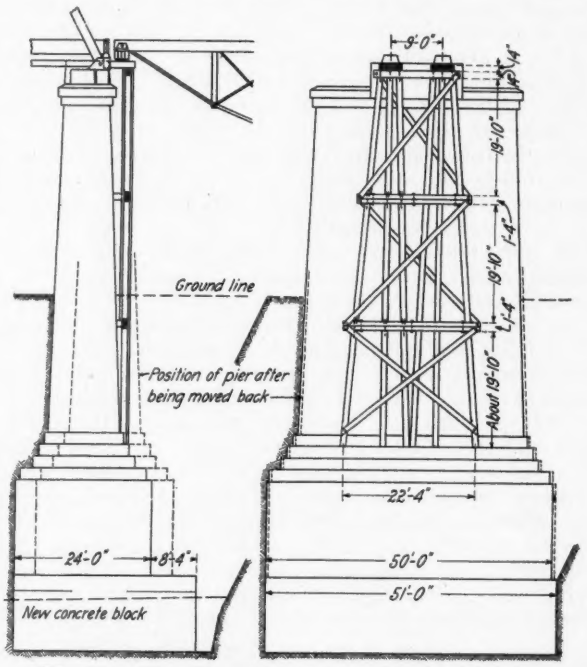
Between 1904 and 1911 there was practically no movement in the pier. In the meantime the superstructure had become too light for heavy power and new steel designed for E-52 loading was placed in 1905. All of the old masonry except the east abutment was used to support the new steel but the sliding of the bank made it necessary to lengthen the east span and it is now supported on piling capped with a timber grillage. The slope beyond the steel span is taken care of by a 15-ft. timber span.

For a number of years after 1904 the open pit back of Pier I was maintained, but it finally became filled with wash material from the slope and pressure was again brought against the pier. Previous to 1904 all measurements of movement were taken from the steel work. After the new steel was placed no movement was detected in the roller bearings and a record of movement was not maintained, but in 1912 it was decided to institute monthly measurements made along standard lines with adjustments for temperature. From 1912 to 1917 Pier I moved 12 in. In 1917 it moved 12 in. more. During the winter months the pier was stationary, so that in 1917 the movement exceeded one inch per month.

Movement Again Serious

It became evident that something would have to be done to stop the movement, or a support provided for the spans meeting on the pier. The expansion bearings of both spans rest on Pier I and the movement was taken care of by adjusting the rollers. Plans were prepared for building a new pier east of the present one and joining the two at the top with a concrete girder, which would provide a flat surface 30 ft. long that could move under the supports of the span.

The excavation for such a pier was made, requiring a pit 50 ft. by 40 ft. for the full depth of the foundation. By constructing a cofferdam in such a way that pressure does not bear against the existing pier, it has remained stationary and the pit will be left open during the life of



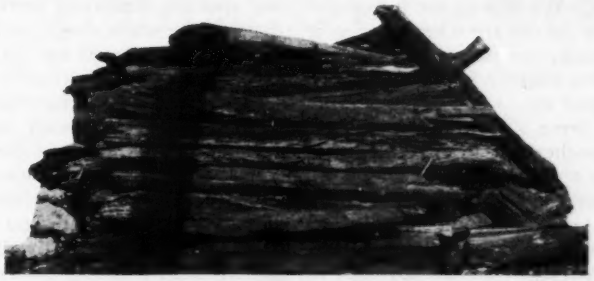
The Pier Was Moved Back on a New Sub-footing

the timber in the cofferdam. This method of maintaining the pier has proved very satisfactory. There has been no movement from December, 1917, to date. The question of building a new sliding pier is still open and future developments will determine whether it is best to build such a pier or renew the cofferdam when its life becomes spent.

The early methods used to maintain the pier were based on the assumption that the bluff is moving on a plane surface and that the movement has been aggravated by the leakage of water from the city reservoirs. There is no doubt that the bluff is moving and that the water, either from springs or the reservoirs, has had something to do with the rate of movement, but the theory that the movement is on a plane surface is probably erroneous. The movement of the bluff is greatest at the surface and decreases to zero somewhere near the bottom of the pier. This is clearly shown by the fact that a 16-ft. timber span at the east end of the 140-ft. span moved about 14 ft. from 1904 until 1917 and the bottom of the pier moved 26 in. during the same period of time.

Tie Renewals Are the Largest Expense

This Item of Expense Should be Watched Closely to Avoid Extravagance



Careful Selection of the Actual Units Replaced Will Insure Against Waste

TRACK FORCES are now engaged in the renewal of ties. Over one hundred million ties will be substituted in tracks for others which will be withdrawn and burned this season. The cost of the renewals constitutes the largest single item of maintenance of way expense. The importance of scrutinizing this expenditure closely is therefore self-evident. For this reason we present below two discussions of this subject, the first of which deals primarily with the selection of the ties for renewal and the second with the operation of replacing the tie.

Be Stingy With Ties

By James Sweeney

Supervisor, Chicago & Eastern Illinois, Danville, Ill.

Some time this fall the roadmaster will receive orders to prepare his tie budget. At least it is to be hoped that he will receive such orders, for this is no job to be handled over a desk. I believe the general practice now is to refer the entire question to the roadmasters. There are a number of ways to prepare the budget. One "good" way not to do it is to go on a motor car. An "even better" way not to proceed is to go over the line on the back end of a passenger train. The only right way is to take the section foreman and walk, and if I succeed in proving my point it will be agreed that the walking should be slow.

Making the Inspection

The only tools needed are a blank book, a pencil and an adze. The pencil being mightier and lighter than the adze, we will not quarrel with the foreman when he offers to carry the adze. As we go along we will permit the foreman to tap the suspicious looking ties with the adze while we assist him to listen. If we are convinced beyond a reasonable doubt that the tie is bad we will then take the second step, which consists of making an entry in the book while the foreman deftly cuts off a corner of the tie with the business end of the tool before mentioned. If everything goes right, we will cut the corners from one to two ties in each rail length, making about three hundred little marks in the book for each mile. When the end of the section is reached we will meet another foreman with a sharp adze and so on day after day until the whole district is covered.

Now that we have the little book full of figures, we will forget the foreman and the walking while the clerk counts them up and makes a little list on the typewriter, which we sign. However, we are not through, but have just started.

Let us suppose that our district is a part of one of two big roads that jointly reach from the Atlantic to the Pacific. Our report is combined with many similar reports and they are incorporated into the budget. On those two roads alone the expenditure for ties and labor to apply them aggregates $15,000,000. That is a lot of money. On rail and rail labor only five millions is spent, on roadway maintenance only five millions more, on repairs of all buildings only six millions. Off hand we would say that any of the three classes of work just cited would cost as much in a year as ties, yet in a year of severe retrenchment almost as much was spent on ties as on all three of these items combined.

Another combination on the same two roads shows an even more startling comparison. Their entire expenditure for the class of work usually done by section and extra gangs totaled $37,000,000 and of this $15,000,000 was spent for ties and tie labor. Forty per cent of all section and extra gang costs was attributable to ties.

The Tie Investment

We do not think of the tie as being a very large part of the investment of a railroad. We ride the full length of such roads as I have referred to and notice the deep cuts and heavy fills, the tunnels and bridges, the terminals and towering office buildings; we even remark about the weight of rail and the kind of ballast, but I have yet to hear a single comment upon the ties of any railroad as long as the train stays on the track. These two roads operate over thirty-one thousand miles of main and side tracks. Their total investment in road is over a billion dollars and over one-tenth of this investment is in ties. The only reason that their investment is that low is because the road was built many years ago. If they were building these lines now the investment would be nearer one hundred and fifty million dollars.

We all know what will happen to that investment for ties during the next ten years. It will all be hauled out on the right of way and burned, for we have a law of averages that says that the life of a tie is ten years.

That ten-year average life of a tie must be lengthened and the only people who can do a single thing to add another day to that ten years are the roadmasters and the section foreman. That is why I said that there was a reason for walking slowly when you make up your tie budget. What ties are you going to take out and what ties will you leave in? I don't counsel leaving in a string of ties that will not hold the spikes, but I do believe in getting the last day's use out of any tie that is safe to leave in. The roadmaster can spot his ties for renewal to the best of his judgment, but when it comes to actual replacement the foreman is the man who must assume the responsibility.

A Tie for Every Condition

There is a kind of tie for every place. It is our business to find out what kind of a tie is needed for each piece of track and then make life miserable for the tie agent until he gets it. The tie agent is satisfied in his own mind that a properly treated hard maple or red oak tie will last 25 years under favorable conditions. Between the average 10 years of life that we get out of a tie and the 25

years that the tie agent believes he is giving us in a treated tie, there is surely enough margin for us to work on to raise the standard.

The treated tie is expensive. We like to use it because we believe we are building for the future when we put it in the track, but not all side tracks can justify treated ties. I have had my troubles with a branch line laid entirely with cedar ties which developed into a heavy traffic line. I had so much trouble with these soft wood ties that I thought I never would put another one in any track if I could find anything else. I do not know that I have had a complete change of heart yet, but I have been doing some serious thinking. Not long ago, while visiting another road, I was shown a cedar tie that would still hold the spikes, which the tie department claimed had been in track 52 years. Conditions had to be ideal for a tie to last such an unusual time. The drainage was perfect and the traffic exceptionally light. It is our job to see that conditions are made as nearly ideal for all our ties as it is within our power to do. In making those conditions, we are in a great measure dependent on the policy of the management in the matter of tie plates and rail anchors, but their worth has been so well proven in recent years as to make their future supply assured when they are actually needed.

As a last word, I would suggest to all roadmasters that they think seriously about ties and tie costs before they start on their fall inspection and that they make the trip over each section a real tie visit with the foreman. Try to get him to see the tie as representing two-fifths of all his work and then next summer when the ties are being put in make it a point to look over the ties that have been taken out and see just how well the lesson was learned.

The Renewing of Ties

By F. J. Meyer

Assistant Engineer, New York, Ontario & Western, Middletown, N. Y.

The importance of tie renewals has been brought to the front very forcibly during the past few years by the increasing shortage of good tie timber and the high cost of labor. Its importance, however, has by no means placed the matter of tie renewals in the position that economical maintenance demands.

Probably the ideal condition would prevail if a 100 per cent track man could go into the woods, select a perfect white oak butt, season it, treat it with creosote and put it in the track, being very careful that his line, gage and surface were right before he did it. Unfortunately this is impossible, so the solution seems to be not to remove any tie unless it should be removed, for fear you may put a poorer tie in its place. This practice automatically leads to spot tie renewals, which today are generally accepted as the most economical method. Of course, this method presupposes that a reasonably high standard of maintenance exists.

With this method the first proposition is the selection of the ties which are to be removed and their location so the new ties can be unloaded with proper thought for the work the ties must perform. The large oaks, for instance, should be unloaded for use on curves, while the softer ties can be more economically used on light tracks and tangents. This distribution will probably take place some time before tie renewals actually begin and in making the distribution care should be used to pile the ties so that they do not have to be trucked a great distance or up hill if the section is on a grade.

It is important that the entire section be picked up and lined before actually starting tie renewals. This work, properly done, contributes very largely to the final success of the tie renewal program, because when actual tie renewals are started the men are less likely to be called to fix up rough track elsewhere and also because, in making spot tie renewals, there is then no good excuse for making the track rough as is so often done. Wide gage should be corrected and where the rail has rolled out it should be rolled back so that it has the proper position. This must be done before the new ties are put in else these ties will be ruined quickly, and it will be necessary to adze the new ties as much as the old.

It seems that the tie renewals can be best made under ordinary traffic with the men working in pairs, after the ties have been actually laid on the ground preparatory to renewing. A very satisfactory way is to provide each pair of men with two shovels, one pick, one maul, a pair of tie tongs and a claw bar with the opposite end shaped into a pinch bar. The spikes are drawn entirely from the tie which is to be removed and started on three ties on each side of the one which is to be removed. The ballast is loosened on each side of the tie to be removed. The pinch bar is placed under the rail and the rail raised enough to slip a spike or wedge between the tie, next to the one which is to be removed and the rail. The bad tie is then pulled out and the old bed prepared to receive the new tie, care being taken not to dig deeper than necessary. The new tie is then pulled in place. The next operation depends on the kind of ballast. If in stone or screened gravel it is better to let the rail down on the tie before tamping, while in cinders and unscreened gravel it is better to tamp the tie so that it is a little stiff. Of course, great care must be used in this, because when the engines do the tamping good judgment is necessary or the new ties will be a trifle stiff. The new tie is now spiked, the spikes in the adjoining tie tapped down and the ballast dressed. The two men then move to the next tie.

With this method two men will renew about two ties an hour under average conditions and a section gang of 6 men, with a moderate distance to truck, will truck out 50 ties, renew them and pile the old ties in eight hours. These figures vary, of course, on different parts of one road, while some gangs will do almost as well in stone as others in cinders. The advantage of this method lies in the fact that the roadbed is not disturbed much.

The method also distributes the men so that they have more freedom of action. It gives an opportunity to pair them off so that each outfit will try to at least hold its own. As no jacks are used, the work can be carried on as a rule without flag protection. The greatest disadvantage seems to be the danger of running over the rails with the spikes between the ties and the rails. This happens very seldom and can be avoided entirely with ordinary care. One of the objections to the use of the jack in tie renewals is the disturbing of the roadbed due to jacking the ties and rail out of place. A tie will come out somewhat easier if the rail is jacked high, but with hard ballast it is not likely to go back as it should. Of course, there is also the danger of jacking out of line.

When track is being raised out of place and tie renewals are being made it is better to pull the spikes from the ties which are to be removed and the new ones put in while the track is jacked up than it is to dig them in before the raising. This also gives the foreman a chance to see just what condition his ties are in. If it is desirable to restrict the tie renewals closely, when track is being raised out of face no spikes should be drawn and the renewals should be limited to only such ties as will not be held up to the rail by the spikes. This insures economical renewals and safe track for a period of at least one year, for it is safe to say that the average tie that will hang to the spike is good for some service.

Electrical Resistance of Treated and Untreated Crossties

Progress Report on Tests Made by Forest Products Laboratory on C. M. & St. P. Tracks Suggests Interesting Conclusions

By P. R. Hicks

Formerly Engineer in Forest Products, United States Forest Products Laboratory, Madison, Wis.

THE RESULTS obtained in a series of measurements made by the Forest Products Laboratory to determine the electrical resistance to the earth of rails on untreated ties and rails on ties treated with various preservatives are presented herewith. This study was undertaken in 1916, at the suggestion of the Bureau of Standards, and was carried out in co-operation with the Chicago, Milwaukee & St. Paul.

The track upon which the measurements were made is maintained by the railway and the laboratory near Madison, Wis., for service tests of experimentally treated ties. It includes red oak ties treated with various preservatives at the laboratory, Burnettized red oak ties treated at a commercial plant, and untreated white oak ties. It is on a sandy gravel ballast, and has 75-lb. rails with joints opposite and 6-½ in. by 8-½ in. tie plates, single spiked with 9/16 in. cut spikes. For the electrical resistance tests the track was divided into seven sections, each of which was insulated from adjoining sections by insulated rail joints. Each 165-ft. section contained 100 ties laid out of face, or 20 to the 33-ft. rail.

View of the Test Track

The following is a brief description of the ties.

Section 1. Red oak ties treated at a commercial plant with 0.55 lb. of zinc chloride per cubic foot. A 4 per cent solution of the preservative at a temperature of 150 deg. F. was used under pressure for five hours. The pressure used is not known. No initial or final vacuum was drawn. The ties were seasoned for one year before and one year after the treatment.

Section 2. Same as section 1, except that the ties had been soaked in the lake for 26 hours and scrubbed with a broom before laying.

Section 3. Red oak ties treated at the Forest Products Laboratory with a mixture of 25 per cent creosote and 75 per cent gas oil, with an average absorption of about 10 lb. per cubic foot. The ties were seasoned for 18 months before and 6 months after treatment. The oil was a paraffine-base petroleum oil from which the gasoline and other volatile oils had been removed by distillation. This oil was obtained from the stock of the local gas company, which uses it to make water gas.

Section 4. Same as section 3, except that a mixture of 10 per cent creosote and 90 per cent gas oil was used.

Section 5. Untreated white oak ties.

Section 6. Untreated ties of various species which had been in place for several years.

Section 7. Red oak ties treated at the Forest Products Laboratory with 0.515 lb. of sodium fluoride per cubic foot. A 3.35 per cent solution of the preservative and a temperature of about 150 deg. F. were used, with a maximum pressure of 150 lb. per sq. in. The treatment consisted of a preliminary vacuum of 1 hour, followed by a pressure period varying from 3 to 6 hours, and a 15-minute final vacuum. The ties were seasoned for about 1 year before and 2½ months after treatment.

A diagram of the test track and the connections for making the resistance measurements is shown in one of the photographs. Connections to the rails were made by passing the bare wire through small holes drilled in the rails and wedging them tight with channel pins.

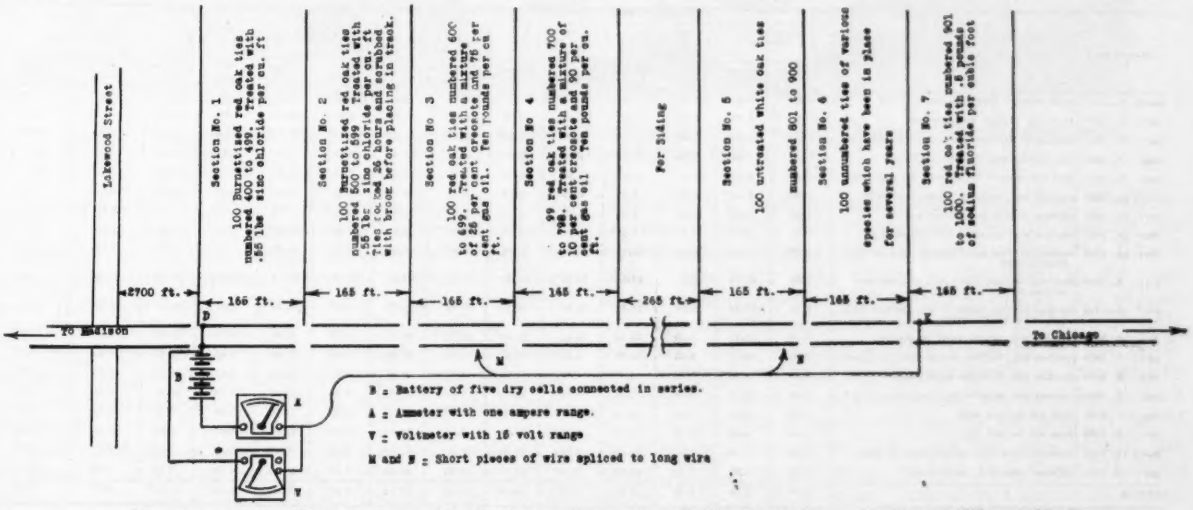


Diagram of the Test Track on the Chicago, Milwaukee & St. Paul, Near Madison, Wisconsin

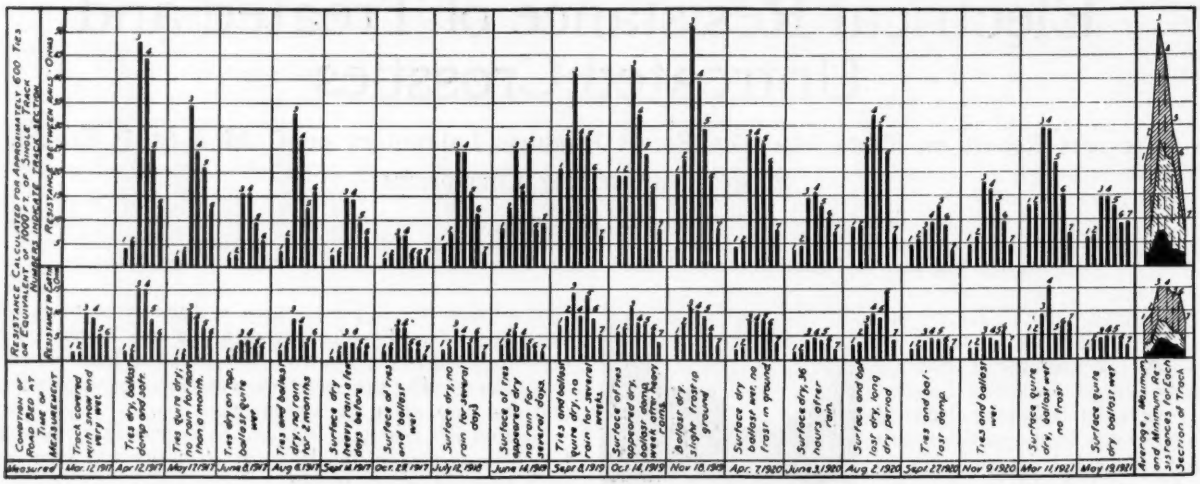


Diagram Showing the Results of the Resistance Measurements, in Terms of the Resistance Between Rails Expressed in Ohms

After the work was started it was decided to amplify the experiment by recording the resistance between rails of each section. These measurements, it was thought, would serve as a check on the other measurements and might give additional information of value.

The results of the measurements made from March 16, 1917, to May 19, 1921, with a brief statement showing the condition of the ties and ballast, are given in the table. The resistances are calculated for approximately 600 ties, or the equivalent of 1,000 ft. of single track with the ties spaced 20 to the 33-ft. rail. The diagrammatic presentation of the same data facilitates comparison of the different measurements.

The results of this experiment are presented as a progress report only. The reader should not accept them as an accurate measure of the difference in resistance between different preservatives. The condition of the ballast has a great influence upon the results, as measurements on different days show. It will be noted, for instance, that water on the surface of the ties or in the ballast affects the resistance to a greater extent than differences in treatment. It is possible also that the results are affected by other factors. The data are of interest, however, in that they are believed to be the most comprehensive set of measurements of the kind. To obtain a close approximation of the average leakage of current through ties subjected to various treatments, numerous similar measurements will have to be made on test tracks in other localities and with other ballast and climatic conditions.

The old ties in the track gave a lower average resistance than the untreated white oak ties, but both of these sets showed greater resistance than the ties treated with zinc chloride or sodium fluoride. The greatest resistance in the test was shown by the oil-treated ties.

The deduction cannot be made from these figures that ties treated with zinc chloride or sodium fluoride should not be used in tracks where signal systems are in use. Signal engineers have known for years that the resistance of zinc-treated ties is relatively low and that difficulties may be encountered upon new track laid entirely with them. However, when zinc-treated ties are used for replacements in old track they do not seem to cause much trouble, unless too high a percentage of ties is replaced at one time.

With the foregoing considerations in mind attention may be called to a few facts indicated by the data. It will be noted upon examining the table and diagram that there was no appreciable difference in the resistance of the ties treated with zinc chloride and those treated with sodium fluoride. The average resistance for the latter falls between the figures for the zinc-treated ties.

Date of test	Condition of roadbed	Resistance in Ohms, calculated for approximately 600 ties or the equivalent of 1000 feet of single track															
		Section 1 Zinc chloride		Section 2 Zinc chloride scrubbed		Section 3 25% Creosote 75% Gas oil		Section 4 10% Creosote 90% Gas oil		Section 5 White oak untreated		Section 6 Old ties		Section 7 Sodium fluoride	
		To earth	Between rails	To earth	Between rails	To earth	Between rails	To earth	Between rails	To earth	Between rails	To earth	Between rails	To earth	Between rails
March 16, 1917	Track covered with snow and very wet	1.61	----	1.99	----	9.77	----	8.90	----	8.85	----	4.74	----	----	----
April 12, 1917	Ties dry; ballast damp and soft	2.01	4.27	1.80	5.26	15.11	48.00	15.11	44.80	8.82	24.89	4.72	13.36	----	----
May 17, 1917	Ties quite dry, no rain for more than 1 mo.	0.80°	2.22°	0.96°	3.22°	10.22°	34.80°	9.42°	24.70°	6.09°	21.80°	0.18°	12.41°	----	----
June 8, 1917	Ties dry on top; ballast quite wet	1.25	1.91	1.50	2.76	4.35	15.65	4.35	15.71	3.04	9.50	2.29	5.81	----	----
Aug. 6, 1917	Ties and ballast dry, no rain for 2 months	2.14	3.48	3.12	6.42	8.50	32.79	7.46	27.00	3.45	12.65	4.80	16.04	----	----
Sept. 14, 1917	Surface dry; heavy rain few days before	0.85	2.84	1.50	3.15	3.99	14.64	3.79	14.26	3.00	9.66	2.19	6.82	----	----
Oct. 28, 1917	Surface of ties and ballast wet	1.88	1.88	2.82	2.83	6.65	6.65	6.65	6.63	2.71	2.71	2.52	2.52	1.45	1.83
July 12, 1918	Surface dry, no rain for several days	2.21	4.95	2.97	7.19	6.60	24.50	5.25	24.80	3.30	15.51	6.12	11.41	1.95	3.31
June 14, 1919	Surface of ties appeared dry, no rain for several days	3.57	8.22	4.49	12.15	6.52	24.61	4.83	16.19	3.29	26.28	2.18	7.97	1.99	9.21
Sept. 8, 1919	Ties and ballast quite dry, no rain for several weeks	7.89	20.71	9.58	27.65	14.28	41.28	9.38	27.49	13.35	27.61	8.67	20.60	8.38	6.84
Oct. 14, 1919	Surface of ties appeared dry, ballast damp. Week after heavy rains	8.94	19.80	6.24	19.32	11.08	42.31	7.92	32.31	7.58	23.96	8.94	16.10	8.48	7.89
Nov. 18, 1919	Ballast dry, slight frost in ground	8.25	19.26	7.19	22.68	11.11	51.20	10.34	39.30	9.22	29.32	5.75	18.40	8.17	8.06
April 7, 1920	Surface dry, ballast wet, no frost in ground	2.29	4.22	2.66	4.80	8.06	27.80	8.06	27.80	8.44	25.09	7.02	21.70	3.61	7.66
June 3, 1920	Surface dry, 36 hours after rain	1.56	3.35	1.72	4.09	4.11	14.35	4.62	15.66	4.06	12.94	3.66	10.14	1.60	7.31
Aug. 2, 1920	Surface and ballast dry; long dry period	3.04	8.37	3.68	9.25	7.84	25.70	8.66	21.99	8.86	29.87	13.84	25.35	3.98	6.69
Sept. 27, 1920	Ties and ballast damp	1.96	4.44	2.89	5.64	3.83	12.70	4.39	14.14	4.08	12.70	3.26	8.46	2.47	3.07
Nov. 9, 1920	Ties and ballast wet	2.16	4.88	2.32	6.19	4.64	17.60	4.14	16.01	3.86	13.26	5.61	9.50	3.18	4.53
March 11, 1921	Surface quite dry, ballast wet, no frost	5.04	12.55	5.10	12.63	9.13	29.95	15.20	29.61	5.02	22.12	6.86	15.20	7.70	6.93
May 19, 1921	Surface quite dry, ballast wet	1.96	5.79	3.20	6.46	4.18	16.44	4.61	16.44	4.61	12.16	5.38	8.68	2.69	9.80
AVERAGE		2.78	7.24	3.38	8.92	7.88	25.60	7.80	23.46	5.70	22.32	5.15	12.66	3.81	6.32

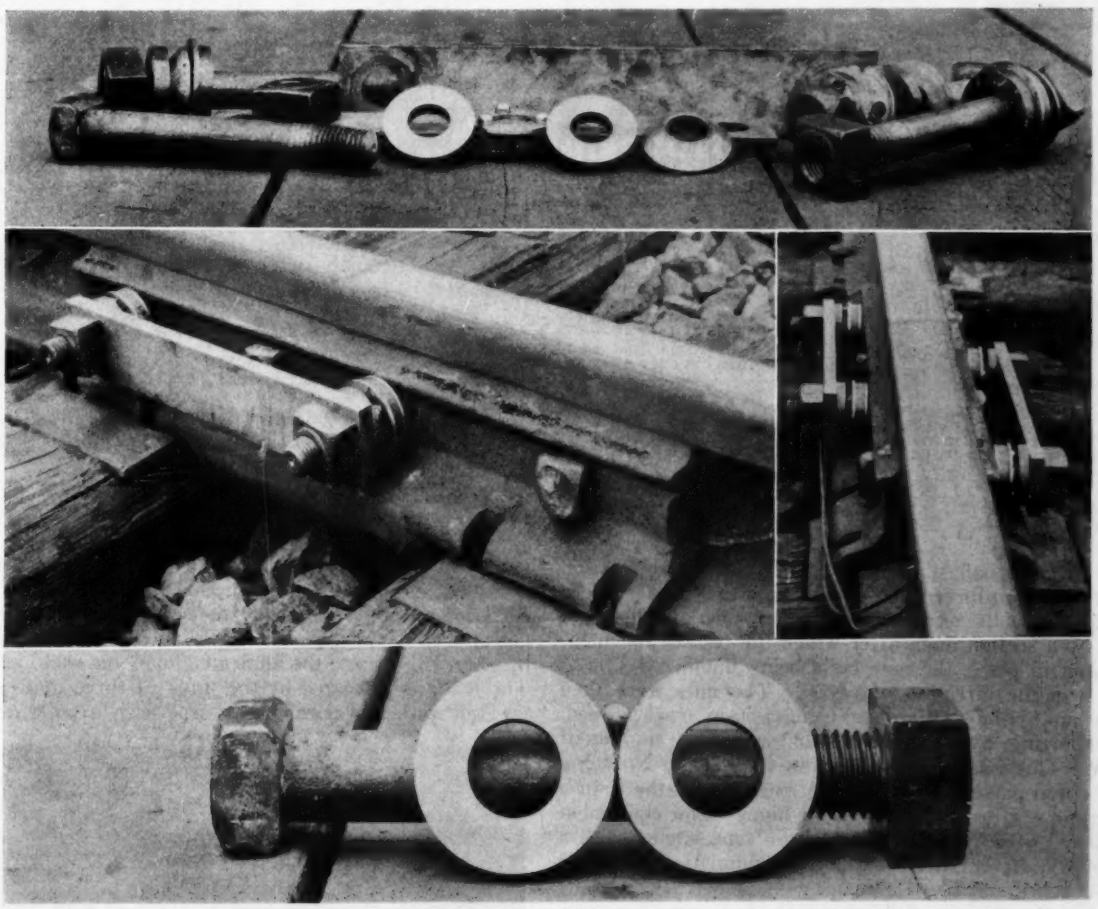
Electrical Resistance to Earth and Between Rails of Test Track

Some Interesting Tests of Impact Loads on Track Bolts

A Unique Method Developed to Determine the Stresses Induced by a Train, an Engine and the Pull of a Wrench

A NUMBER of tests made recently on the Philadelphia & Reading by the National Lock Washer Company, Newark, N. J., working in conjunction with the officers of the road, have resulted in some interesting data on the stresses induced in track bolts. The method which was developed to secure this data is somewhat unique in that the Brinell system for testing hardness of metals was employed to register the loads. Determinations of four loads were made. These included the loads resulting from the impact of a high speed passenger train, a fast-running freight locomotive, the normal pull exerted by a 160-lb. trackman on a wrench and the pull exerted by running up the nut until the bolt broke. The average minimum and maximum loads on the one-inch bolts used were 25,980 lb. and 29,298 lb.

The underlying principle of the method consisted of the forming of impressions upon hardened steel washers, through the medium of standard Brinell balls, by the loads which it was desired to determine. The equipment, which was developed, is shown clearly in the illustrations and was for use with a four-hole joint. It consisted of four standard untreated one-inch bolts such as are used in insulated track joints (the standard track bolt being too short); four coned filler blocks with an angle of 41 deg. from the largest diameter face; eight hardened steel washers, 2¼ diameter and ⅜ in. thick, four 3-ball retaining washers, two steel-bars used to prevent the washers from turning and the necessary nuts and Brinell balls. The bolts were placed in the holes in the customary manner, after which the coned blocks were slipped over the bolt, the small end being next to the joint web. This was done to secure a perfect bearing for the hardened washers, to hold the bolt properly in line and to obviate any effect from the shoulder on the joint as well as from possible irregularities on its surface. A hardened washer was placed over the bolt and against the coned block, the retaining washer and three 10 millimeter balls next to that, and then another hardened washer. The steel bars were then placed across the pro-



Top—The Test Joint with Parts Disconnected. Center—The Test Joint in Position. Bottom—The Washers with Indentations Produced by the Balls

jecting ends of alternate bolts and the nuts screwed on. The washers were made from crucible steel having about 0.90 carbon and were heat treated by quenching in oil at 1550 deg., Fahrenheit and drawing at 600 deg.

The field tests were made on the southbound, high-speed, main track of the Philadelphia & Reading at a point opposite tower "PW," slightly over 2½ miles north of Norristown Junction, Pa. The track at this point was laid with the Pennsylvania Steel Company's Section 165, open hearth, 100-lb. rail on tie-plated, creosoted pine ties, on stone ballast. It was in good line and surface. Four hole, reinforced angle bars were used.

The old bolts were removed from one of the angle bars by a section man, after which the test arrangement was put in place, the new bolts being numbered 1, 2, 3 and 4 in the direction of travel. The nuts were then pulled up by the section man, using a 36-in. track wrench and applying, as nearly as possible, a normal amount of force. This was done in preparation for train No. 92, a high-speed passenger train which passed over the joint a short time after, at 58 miles an hour. The equipment consisted of a fairly heavy Atlantic type engine with a weight on drivers of 129,210 lb.; a combination car, three day coaches and two Pullmans.

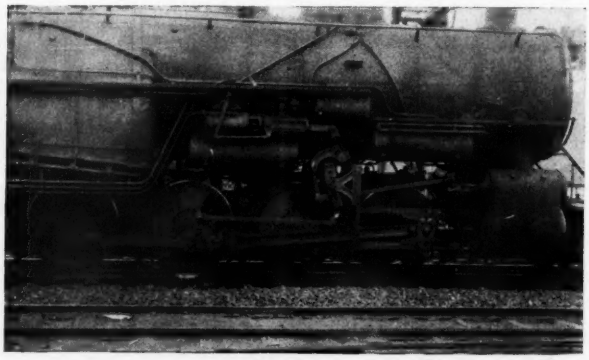
After the passage of this train, the nuts were loosened, the impressions marked for future identification and the washers turned through a small angle to secure a new bearing surface for the balls. The nuts were then run up and a heavy Consolidation engine running light at 45 miles an hour, was run over the joint. The weight on the drivers of this locomotive was 251,920 lb., the weight on the third pair of drivers being 64,690 lb. The drivers were 53½ in. in diameter. The locomotive was stopped gradually, backed up to the joint and stopped with the third pair of drivers exactly over the joint to locate the position of the counterweight. The position indicates that the joint was neither subjected to a maximum nor a minimum stress but one more nearly approaching an average.

Following this test, a new surface was again brought into position and the nuts tightened by the same section man to secure the load produced by the pull of the wrench. Another surface was brought into position after this had been done and a nut on one of the bolts tightened until it broke. The hardened washers, carefully marked for identification, were taken later to a testing laboratory where each washer was subjected to a test load of 10,000 lb., using a Brinell ball of the same diameter employed in the field test. This was done to determine the unit resistance to pressure offered by each washer from which the actual field loads could be calculated. The diameters of the impressions were measured microscopically to hundreths of a millimeter, after which they were converted to inches. Each impression was measured separately but in making the calculations the average diameter for each unit of three impressions was used and the load determined from this average diameter was multiplied by three to secure the indicated load on each washer. The load, as indicated by the units of three impressions on each washer, was calculated separately after which the results for the two washers on the individual bolts were averaged to secure the load. The final loads were determined from an average of the loads on each bolt. The results give a stress of 26,145 lb. on a one-inch bolt resulting from the passage of the passenger train, 26,374 lb. for the free-running freight locomotive, 25,980 lb. for the wrench pull and 29,298 lb. for the breaking pull. This gives stresses per sq. in. of approximately 47,536

A Table Showing the Results of the Impact Tests

Washer Position Number	WASHER No. 1 Diameter of Impression 1	2	3	Average M. M.	Average Ins.	10,000 lb Test Impression Diam. M. M.	10,000 lb Test Impression Diam. Ins.	Pressure per Sq. In. $H=\frac{P}{2\pi r\left(r-\sqrt{r^2-\frac{D^2}{4}}\right)}$	Load on Each Washer Impression Made in Joint	WASHER No. 2 Diameter of Impression 1	2	3	Average M. M.	Average Ins.	10,000 lb Test Impression Diam. M. M.	10,000 lb Test Impression Diam. Ins.	Pressure per Sq. in. $H=\frac{P}{2\pi r\left(r-\sqrt{r^2-\frac{D^2}{4}}\right)}$	Load on Each Washer Impression Made in Joint.	Sum of Impression Loads Determined for Washers No. 1 and No. 2	Average of Impression Loads Determined for Washers No. 1 and No. 2	Determined Load Placed on Each Bolt for Each Washer Position	REMARKS
				BOLT No. 1									BOLT No. 1									
1	3.4	3.5	3.4	3.43	.1350	3.8	.1496	547,395 lb	8084	3.0	3.0	2.8	2.93	.1153	3.1	.1220	834,376 lb	8906	16990	8495	25485	Passenger Train
2	3.7	3.5	3.6	3.60	.1417				8930	3.0	3.0	2.9	2.96	.1165				9102	18032	9016	27048	Freight Engine
3	3.9	3.3	3.0	3.40	.1338				7935	3.0	3.1	2.9	3.00	.1181				9350	17285	8643	25929	Wrench Pull
4	4.0	3.4	3.7	3.70	.1457				9458	3.2	3.2	3.1	3.16	.1224				10073	19531	9766	29298	Breaking Bolt
				BOLT No. 2									BOLT No. 2									
1	2.9	2.9	2.8	2.86	.1126	3.1	.1220	834,376 lb	8483	3.0	2.8	2.9	2.90	.1141	3.1	.1220	834,376 lb	8720	17203	8602	25806	Passenger Train
2	2.9	2.7	2.8	2.80	.1102				8122	2.9	2.9	2.7	2.83	.1114				8297	16419	8210	24630	Freight Engine
3	2.8	2.7	2.8	2.80	.1102				8122	2.9	2.8	2.7	2.80	.1102				8122	16244	8122	24366	Wrench Pull
				BOLT No. 3									BOLT No. 3									
1	3.2	3.8	3.5	3.5	.1378	3.5	.1378	649,392 lb	10000	2.9	3.0	3.0	2.96	.1165	3.1	.1220	834,376 lb	9102	19102	9551	28653	Passenger Train
2	3.3	3.1	3.2	3.2	1260				8313	3.0	3.0	2.8	2.93	.1153				8906	17219	8610	25830	Freight Engine
3	3.5	3.1	3.7	3.43	1350				9590	3.0	3.0	2.9	2.96	.1165				9102	18692	9346	28038	Wrench Pull
				BOLT No. 4									BOLT No. 4									
1	3.0	2.9	3.0	2.96	.1165	3.2	.1260	781,180 lb	8522	3.0	2.9	2.9	2.93	.1153	3.1	.1220	834,376 lb	8906	17428	8214	24642	Passenger Train
2	3.0	3.4	3.0	3.13	.1232				9556	3.2	2.9	2.8	2.96	.1165				9102	18658	9329	27987	Freight Engine
3	3.0	2.8	3.0	2.93	.1153				8338	3.0	2.9	2.8	2.90	.1141				8720	17058	8529	25587	Wrench Pull

	Average
Passenger Train	26145 lb
Freight Engine	26374 lb
Wrench Pull	25980 lb
Breaking Pull	29298 lb



Position of Counterweight Over the Joint

lb., 47,952 lb., 47,236 lb., and 53,270 lb. respectively, using 0.550 sq. in. as the area at the root of the thread.

The formulas for the calculations are as follows:

$$H = \frac{P}{2\pi R\left(R - \sqrt{R^2 - \frac{D^2}{4}}\right)}$$

$$P_1 = H\,(2\pi R)\left[R - \sqrt{R^2 - \frac{D_1^2}{4}}\right]$$

H = Unit pressure on surface of ball impression made by test load or unit pressure resistance of material in washer.

P = Pressure placed on ball when making test impression = 10,000 lb.

P_1 = Pressure on ball to make track impressions.

R = Radius of ball—5 m.m. in each case.

D = Diameter of impression made by test load of 10,000 lb. in each class.

D_1 = Diameter of impression made when washers were on track bolts.

The test described here was conducted under the direction of J. Howard Horn, National Lock Washer Company, Newark, N. J., and R. B. Abbott, assistant general superintendent, and J. S. Goodman, division engineer of the Philadelphia & Reading, to whom we are indebted for the above information.

Service Results From Some Treated Cross Ties

THE FOLLOWING tabulation gives the results of the inspection of approximately 25,000 ties in test tracks on 20 different operating divisions of the Chicago, Burlington & Quincy. These tracks are located in eight different states. The ties were installed in 1909 and 1910 and had, therefore, been in service approximately 12 years when they were inspected late last fall.

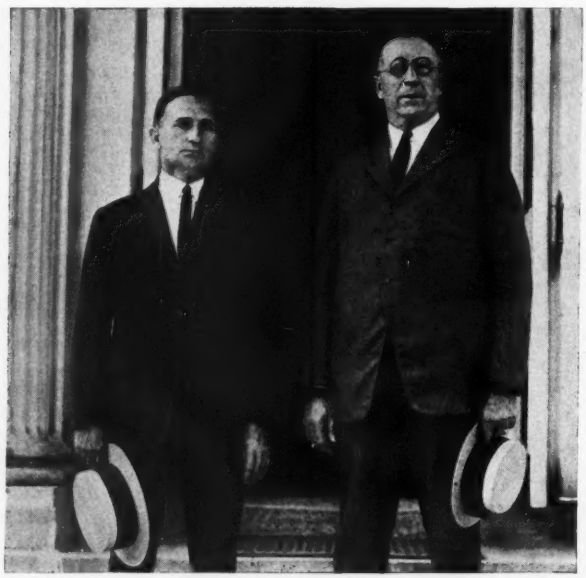
Process	Total Placed	Total Removed to Date	Percentage Removed Account Decay	Percentage Removed Account Other Causes
Ash				
Straight creosote...	35	5	5.7	8.6
Card	389	52	1.8	11.6
Burnett	31	3	9.7	....
Untreated	116	116	99.1	0.9
Birch				
Straight creosote...	134	4	2.2	0.7
Card	1,075	230	6.0	15.4
Burnett	103	36	20.4	14.5
Untreated	217	217	100.0	....
Cypress				
Straight creosote...	54	...	....	....
Card	679	76	0.7	10.5
Burnett	55	4	....	7.3
Untreated	225	187	74.2	8.9
Cottonwood				
Straight creosote...	133	8	0.8	5.3
Card	456	72	1.5	14.3
Burnett	...	...	....	....
Untreated	86	86	96.5	3.5
Elm				
Straight creosote...	328	21	1.8	4.6
Card	958	76	2.7	5.2
Burnett	296	35	4.7	7.1
Untreated	190	187	91.6	6.8
Poplar				
Straight creosote...	80	7	....	8.7
Card	645	213	7.1	25.8
Burnett	80	23	8.7	20.0
Untreated	125	125	96.8	3.2
Hard Maple				
Straight creosote...	116	2	0.9	0.9
Card	832	81	2.3	7.5
Burnett	65	2	1.5	1.5
Untreated	120	120	99.2	0.8
Pin Oak				
Straight creosote...	321	2	....	0.6
Card	832	49	0.7	5.2
Burnett	68	5	1.5	5.9
Untreated	126	123	94.4	3.2
Loblolly or Sap Pine				
Straight creosote...	205	18	1.5	7.3
Card	1,345	296	10.8	11.2
Burnett	200	110	34.0	21.0
Untreated	250	243	96.0	1.2
Chestnut				
Straight creosote...	...	...	....	....
Card	258	180	3.5	66.3
Burnett	...	...	....	....
Untreated	253	198	21.7	56.5
Red Oak				
Straight creosote...	284	6	....	2.1
Card	1,283	118	1.9	7.3
Burnett	274	54	3.6	16.1
Untreated	204	203	91.7	7.8
Sycamore				
Straight creosote...	90	6	4.4	2.2
Card	521	114	13.8	8.1
Burnett	90	33	28.9	7.7
Untreated	130	130	98.5	1.5
Tamarack				
Straight creosote...	212	11	....	5.2
Card	1,309	121	1.1	8.2
Burnett	214	24	2.8	8.4
Untreated	175	174	98.9	0.6
Tupelo Gum				
Straight creosote...	150	16	2.7	8.0
Card	671	44	0.7	5.8
Burnett	119	32	9.2	17.6
Untreated	136	136	100.0	....
White Oak				
Straight creosote...	40	...	....	....
Card	386	52	6.7	6.7
Burnett	42	3	2.4	4.8
Untreated	125	80	57.6	6.4
Soft Maple				
Straight creosote...	200	32	6.5	9.5
Card	731	150	5.2	15.3
Burnett	182	67	14.8	22.0
Untreated	126	124	100.0	....
Red Gum				
Straight creosote...	137	23	5.8	10.9
Card	661	98	7.6	7.3
Burnett	119	72	41.2	19.3
Untreated	151	151	98.7	1.3
Hemlock				
Straight creosote...	234	21	1.7	7.3
Card	1,299	240	5.3	13.2
Burnett	215	40	7.0	11.6
Untreated	190	190	99.5	0.5
Beech				
Straight creosote...	483	15	0.4	2.7
Card	1,226	194	4.2	11.6
Burnett	315	85	12.4	14.6
Untreated	208	206	97.1	1.9
Hickory				
Straight creosote...	25	1	4.0	....
Card	290	62	3.8	17.6
Burnett	24	1	....	4.2
Untreated	110	110	93.6	6.4
Summary (Regardless of Species)				
Straight creosote..	3,261	198	1.6	4.5
Card	15,846	2,518	4.4	11.5
Burnett	2,492	629	12.0	13.2
Untreated	3,263	3,106	88.0	7.1

No Strike of Maintenance of Way Men

Brotherhood Officers Take Council with Labor Board and President Harding and Refrain from Direct Action

ON JULY 1 the members of the various shop craft organizations in the employ of the railroads of the United States threw down their tools and went home in response to a strike call, thus producing what comprises the first nationwide strike of any class of railroad employees on record. What is of greatest interest to the maintenance of way department of the roads is the fact that in spite of a favorable vote by what is said to be a considerable majority of the members of the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, no strike of these employees has been called by E. F. Grable, the president.

President Grable's motive in withholding a strike order is based on the belief that the grievances of his organization may be corrected by peaceful methods. This idea had its inception in an exchange of comments which took place in the inquiry called by the Labor Board on June 29. In answer to testimony presented by Mr. Grable to the effect that the large strike vote was primarily a protest against a reduction in wages in the face of what the men contended was a very inconsiderable reduction in living expenses, Mr. Hooper asked a very pertinent question.



E. F. Grable, at the Right, Leaving the White House

> Do you think it would be worth anything to your organization and to the members of it to know that if the evident present trend of cost of living continues upward in such a degree as to render an increase in wages just and reasonable, this Board would just as cordially take that matter up and consider that trend of conditions as it considered the contrary at the time of its decision?

Mr. Grable replied that it would be very helpful and Chairman Hooper proceeded to state the assurance more specifically in the following language:

> The Board would like for your organization to understand that at any future time whenever conditions of that sort (an increase in the cost of living) become of sufficient importance and of such an appreciable character, you can predicate a request for an increase in wages on them and come with a reasonable plea of that sort to this Board, you should know and your organization should know, that this Board will as cordially give you an increase as it gave you the decrease and do it because it would be its sworn duty to do it under the Transportation Act.

Assurances thus given that the board would offer every facility for a rehearing of points in controversy were fruitful in withholding the strike order of the maintenance of way brotherhood. The ensuing plan of action for the brotherhood was definitely stated by President Grable in the following statement of July 4:

> After conferences with railroad officials and with the chairman and other members of the Railroad Labor Board, we have determined upon the following course:
>
> First, to instruct our chairmen on each carrier to take up promptly with the management all the grievances and controversies outstanding between the members of our organization and the carriers, for the purpose of negotiating a speedy adjustment, matters to be taken up, among others, to embrace a revision of the recent wage decision of the Railroad Labor Board, certain changes in our rules, and the question of contracting out the labor of the classes of employees included in our organization. That the carriers could not well hesitate to consider a revision of the wages decision is indicated by the fact that many of them have already been offering certain changes favorable to certain classes.
>
> Second, in case of a failure to secure from any carrier fair and reasonable concessions in regard to the various matters involved, to bring these matters before the Railroad Labor Board with the assurance that they shall be given the right of way for prompt consideration and decision.
>
> Third, to continue work under the present wage decision of the labor board under protest, pending the efforts to obtain a satisfactory adjustment.
>
> Fourth, to insist that any revision of wages obtained be made retroactive to July 1.
>
> Fifth, to seek immediately from the Railroad Labor Board a ruling absolving our members from being required to perform the work of striking employees belonging to other crafts.
>
> Sixth, to withhold a strike order pending the carrying out of the foregoing program.
>
> With the best interests of the members of our organization at heart, it is our judgment that more will be gained for them by the program here outlined than could be derived from any other course. We believe that a just and generous public sentiment will sustain us in this policy, and every move necessary to its accomplishment will be most vigorously pressed.

The withholding of the strike order for the maintenance of way employees has not been without difficulty. There have been times during the past month when there was serious danger of a split in the ranks of the brotherhood and many of the general chairmen of that organization were in favor of joining the walkouts and disregarding the refusal of President Grable to call a strike. These indications were contained in a statement by C. C. Carroll, president of the General Chairmen's Association Brotherhood, who said that he had received requests from a majority of the general chairmen to call them together in a meeting at which plans might be made for calling out the men. President Grable, however, has stated that only 24 out of 197 chairmen of the union were in favor of a strike. He also stated that the general chairmen's organization has no power to call a strike.

Considerable of the trouble along this line is said to have arisen from efforts made in certain localities to have the maintenance of way men perform work ordinarily done by members of the shop craft unions now out on strike. President Grable presented a grievance to the Labor Board with respect to this phase of the situation, as

a consequence of which the board issued a resolution to the effect that the carriers have "no right to require an employee to perform work outside the scope of the existing agreement or decision of the board covering the rules and working conditions of the class to which such employee belongs, unless the employee performs such work voluntarily."

Notwithstanding the efforts made to insure peace there have been a number of incipient local runaway strikes, but up to the present these have been of a minor nature and have not assumed dangerous proportions.

That efforts have been made from time to time on the part of the shop craft unions to prevail upon President Grable to call a strike is apparent from conferences which have been held between the president of the maintenance of way employees and the officers of the shop craft unions. President Grable has also held conferences with members of the Labor Board and on July 15 he went to Washington to confer with President Harding and Senator Cummins, chairman of the senate committee on interstate commerce. These conferences at Washington give promise of a plan to amend the Transportation Act to include a specific provision for the payment of a "living wage" to every railway employee.

On his return to Chicago on July 18, President Grable appeared before the Labor Board to take up the matter of a "living wage" as a result of his conferences in Washington and to arrange for immediate negotiations between the railroads and their employees with respect to rules, working conditions, wages, etc. These matters are stated in full in the announcement made by President Grable on July 18.

I have received advice that Senator Cummins, chairman of the Interstate Commerce Committee of the Senate, is going to hold hearings immediately on disputed points in the labor provisions of the transportation act, principally to ascertain how the law may be amended so that the living wage principle would be made clear so that every employee would be granted a living wage.

The basis for the guidance of the board in the present act is to set "a just and reasonable wage." The present issue which should be settled by such a hearing by the Interstate Commerce Committee of the Senate and amendment to the law giving an interpretation of the phrase, "just and reasonable" and its application to a living wage.

I told the board that I thought this phrase in the transportation act intended that the humblest railroad worker should receive a wage which would permit his living and rearing a family according to modern standards of health and decency and employees in the grades above should receive differentials for skill, hazards and responsibilities. I also advised the board of instructions I issued and sent to each of the general chairmen throughout the United States to immedately open negotiations with their respective roads on rules, working conditions and wages, and if they cannot be satisfactorily adjusted, to submit these disputed matters to the board.

The first of these new disputes has been received by the board coming from the Chicago, Milwaukee & St. Paul Railroad. The officials on that road set aside the thirty-day clause in the existing agreement in order to meet with our representatives to negotiate the matters in dispute and forward the unadjusted matters to the board.

This is the first of many disputed submissions on these subjects which the board will receive very shortly and I respectfully requested the board to give me their assurance that these cases will be set for a hearing at an early date, and I have received assurance of the board that this will be done. I am so going to advise my membership throughout the United States, for I feel that with the pledge of the board for prompt hearings and action on these important matters the path to an early adjustment is open. I have also requested the board that any further decision on these new disputes, more favorable to the men, be retroactive to July 1.

Further progress on the part of the Pennsylvania management in conducting negotiations with its employees through the agency of independent employees' organizations was announced late in June, when the management reached an agreement with its employees in the signal, telegraph and maintenance department, with respect to modification of wages "to conform with lower costs of living, the general conditions of employment throughout the country and the demand from the public for cheaper transportation." This agreement was made independent of any national organization of labor, and is effective as of July 16, instead of July 1.

The classes of employees concerned in these agreements are: Shop craft employees, maintenance of way employees, signal department employees, clerks and miscellaneous forces. The matter of adjusting rates of pay of these classes has been under negotiation for several months. It was handled entirely with committees of employees representing the various classes.

The new schedules of wages differ in some respects from the rates established by the Labor Board for other railroads, but the difference is in favor of the Pennsylvania employees. For the most part, the Pennsylvania System rates are graded in accordance with skill and experience required, and the prevailing rates are generally higher than those established for other railroads.

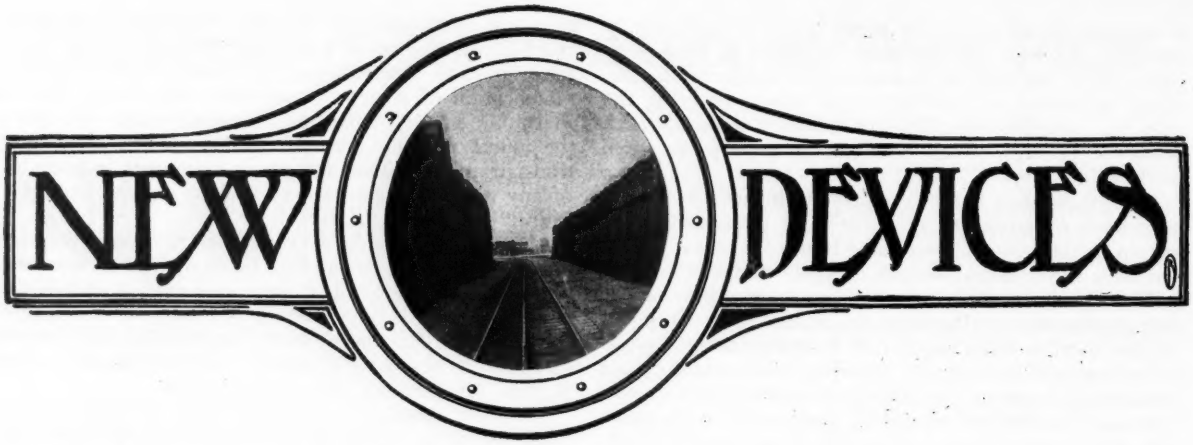
Canadian Roads Propose Reductions in Rates

That the Canadian railroads are following the lead of the American railroads in securing a reduction in the wages of maintenance of way employees is indicated by the following circular effective July 16 and addressed to the employees for the purpose of serving notice of a proposed reduction:

Pursuant to the terms of wage agreement made between the Railway Association of Canada and the Brotherhood of Maintenance of Way Employes and Railway Shop Laborers representing respectively the railways specified in the agreement and the specified classes of employees, the required 30 days' notice for a revision of agreement was issued by the association to the employees' representatives on June 10, 1922, as follows:

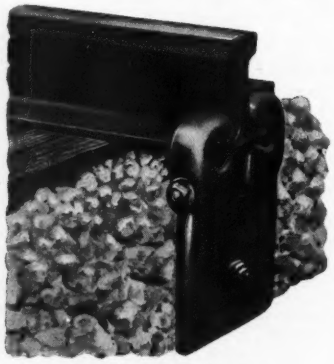
"In accordance with terms of memorandum of agreement dated November 26, 1921, notice is hereby given of the association's desire to revise the rates of pay of employees in the maintenance of way and bridge and building departments covered by wage agreement No. 5, by making the following reduction, effective 30 days from date:

	Decrease of
Foreman of extra gangs, assistant foreman of extra gangs, bridge and building foreman, painter foreman, mason, concrete, bricklayer and plasterer foreman, pile driver, ditching and hoist engineers	$ 0.40 per day
Foreman of signal and interlocking construction gangs	0.40 per day
Section foremen and assistant section foremen, snow plow and flanger foremen	0.24 per day
Pumpmen	10.20 per month
Signalmen at interlocked crossings	10.20 per month
Carpenters, bridgemen or rough carpenters, painters, plumbers, pipe fitters, tinsmiths, blacksmiths, pump repairers, masons, bricklayers and plasterers	0.04 per hour
Bridge and building laborers (west of Port Arthur and Superior Junction)	0.05 per hour
Track and bridge watchmen, signalmen or watchmen at highway or railway (non-interlocked) crossings, signalmen at highway or railway (half-interlocked) crossings, bridge tenders	0.05 per hour
Signal and interlocking maintainers and repairmen	0.04 per hour
Helpers to all classes of mechanics	0.01 per hour
Sectionmen	0.05 per hour
Shop laborers:	
Unclassified (common) laborers	0.05 per hour
Classified laborers, including employees used in lighting up engines, assisting at turntables, cleaning engines, putting supplies on engines and assisting hostlers	0.05 per hour
Ashpitmen	0.05 per hour



The Lundie Duplex Rail Anchor

A NEW RAIL ANCHOR, trade-named "Duplex" because of the fact that it holds against movement of the rail in either direction, has been introduced recently by the Lundie Engineering Corporation, New York. The design embodies some unique features. The prevention of rail movement is secured by direct de-



The New Rail Anchor

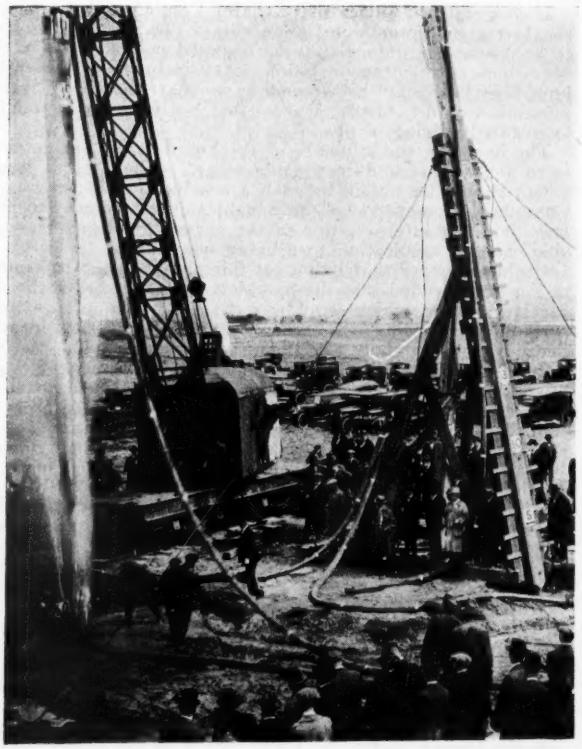
pendence upon the resistance of the ballast acting against a large surface securely fastened to the base of the rail, as shown in the illustration.

The anchor consists of two malleable castings held together and made adjustable in their relation to each other and the rail base by two bolts upon which there is little stress. The two halves of the anchor are identical and consist of large plates recessed to give a continuous surface when the two halves are assembled. The outside dimensions of the anchor when assembled are approximately 9 in. by 12 in., of which a surface about 9 in. by 10 in. is presented below the base of rail. Where the anchor clamps over the base of the rail, the section has been made very heavy, being about 2¼ in. thick along the line of the rail. This gives a section which binds tighter on the base of the rail whenever the latter tends to creep. Only one anchor is used to a rail, the installation being at the center of the rail or, in staggered joint construction, opposite the joint in the other rail. The upper bolt draws the two sections of the anchor together, causing a wedging action of the two jaws on the base of rail, which gives it its initial grip on the rail. The smaller bolt works in a slotted hole to give freedom in adjustability when loosened and to hold the plates rigidly together at the bottom when tightened. The anchor is thus adaptable for use on rails of different weight and cross-sections.

In a five-months' test on an eastern railroad, no creeping of rails was experienced although a creeping of about three inches is normally found in the same period without anchors. No trouble was experienced with signals under varying weather conditions.

A New Type of Sheet Piling

MOST MEN concerned with foundation problems are familiar with the Bignell reinforced concrete piles prepared especially for jetting by the introduction of a system of pipes by means of which water is discharged not only from the bottom of the pile but also



A Test of the Bignell Sheet Pile

from the sides. This arrangement provides both for the excavation of the hole into which the pile is sunk and also for the lubrication of the surfaces of the pile to reduce the friction between the pile and the surrounding earth. Piles of this type have had considerable ap-

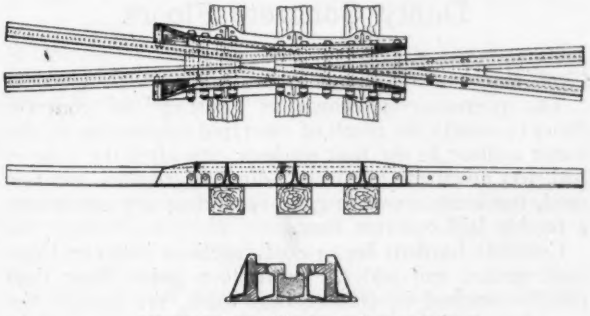
plication to bridge foundation work in locations where considerable depths of sand or alluvial soil are encountered and to use as anchors for current retards for river bank protection.* Further interest is attached to this form of concrete pile by the fact that this principle has now been applied to sheet piling for use in sea walls, dock construction, etc. The one shown in the picture is 10 in. in thickness and has a 20-in. face although the sheet piles may be made in any thickness, width and length that accord with reasonable requirements. They are reinforced and are sunk in the same manner as the other Bignell piles. The tongue of one fits into the groove of the other, making a water-tight wall. If it is desired, thin wood sheets may be inserted in the groove and as these expand with a greater content of moisture they afford a further assurance of water-tight construction. The point of the pile is bevelled somewhat, which tends to force it against the pile previously driven as it makes its way downward to the desired depth.

The possibilities of these piles were demonstrated recently in a test made in Missouri river bottom land near Omaha, Nebr. The first test was the sinking of 40-ft. sheet piles, 10 in. by 20 in. in section, reinforced by ⅞-in. bars and woven wire, and weighing 4.2 tons. The first sheet pile was sunk under water pressure of 175 lb. per sq. in. to a penetration of 36 ft. in 1½ min. The water pressure was turned off and this pile remained stationary in its position during the sinking of the second pile which required 4 min., the same water pressure being applied.

This test was conducted by the Woods Brothers Construction Company of Lincoln, Nebr., who are developing the Bignell piles for various purposes. One important advantage of these piles lies in the ability to sink them of their own weight without the aid of pile driver leads or other guides. All that is necessary is some form of derrick to suspend the pile in the vertical position and slack off on the line as the pile descends into the hole excavated for it by the jet.

New Developments in Special Frog Construction

TO MEET the tendency favored in some circles for the greater use of cast parts in track work as against pieces made from rolled rails by planing or otherwise machining, the Conley Frog & Switch Company, Memphis, Tenn., has developed a solid cast guard rail as an essential feature of its special frog construction.



Details of the Class A Conley Frog

The Conley frog provides the usual flangeways and treads for the wheels with the addition of raised guard rails enclosing the frog construction on each side. These guard rails are at such a distance from the gage side of the rails forming the frog that they will just clear the outside of the wheels passing the frog when properly positioned, i. e., with the wheel flange in the correct position in the flangeway. Any tendency for the wheel to depart from this location is prevented by the outside of the wheel coming in contact with the guard on the frog. This construction, of course, eliminates the usual guard rails attached to the two outer rails of each track at the frog.

As shown in the drawing, the guard rail construction in the frog is accomplished by the use of solid cast alloy steel guard rails in the place of specially machined rails, thus eliminating the necessity for the use of plates and braces, that is, the casting serves both as a guard rail and as rail braces. These castings weigh about 200 lb. each for 85-lb. and 90-lb. rail and are assembled with the rest of the frog construction with the use of 1⅛-in. high-carbon, heat-treated bolts. These frogs can be made in any of the usual frog angles and rail sections. This form of construction has been in service for a considerable period. It is known as the Class A Conley Frog.

A New Type Adjustable Rail Brace

The Morden Frog & Crossing Works, Chicago, has recently placed on the market a new type adjustable rail brace especially adapted for interlocked switch and derails where close adjustment is essential. The device is intended for general use on slip switches, guard rails or ordinary split switches but is particularly useful when

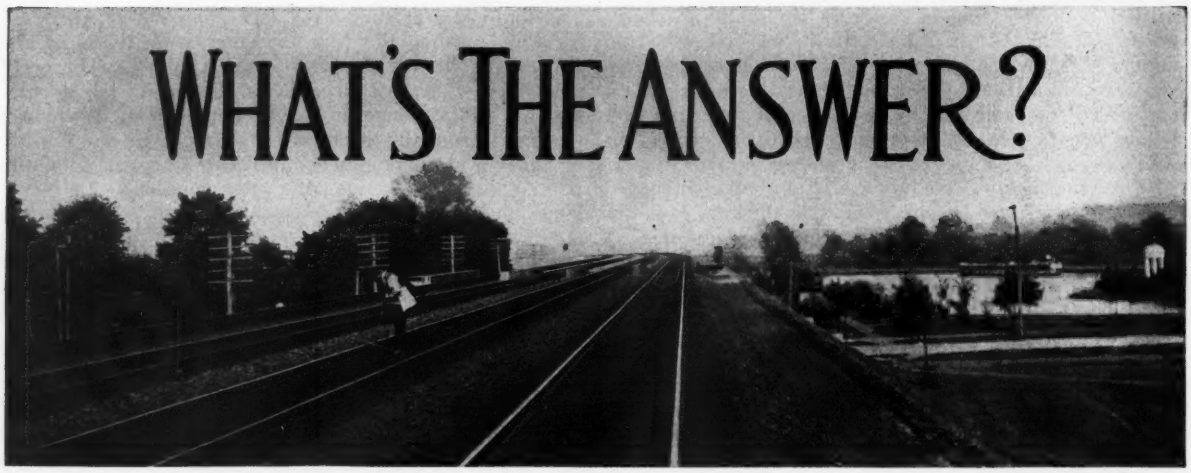
Morden Adjustable Rail Brace

gage plates are used. The construction of the brace is simple and can be installed and adjusted without disturbing the rail, tie or plate. No lateral movement of the brace is required for adjustment, and it maintains its position centered on the plate. The adjustment is easily made, as the wedge can be tightened without loosening the bolts. Any form of suitable fastenings such as through bolts, lag screws or square shouldered counter sunk bolts can be used.

MOTION PICTURES ON TRAINS—On June 17 the Illinois Central demonstrated the feasibility of motion pictures on a moving train on its train No. 3 operating between Chicago and New Orleans. After hanging a curtain at one end of the dining car with the chairs rearranged to face it, the passengers were invited to the diner and a three-reel film was shown.

*This use was described in an article entitled "A New Type of Bank Protection" which appeared in the *Railway Maintenance Engineer* for October, 1921, page 354.

WHAT'S THE ANSWER?



This department is an open forum for the discussion of practical problems of maintenance of way and structures. Readers are urged to send in any questions which arise in their work in the maintenance of tracks, bridges, buildings and water service. The *Railway Maintenance Engineer* also solicits the co-operation of its readers in answering any of the questions listed below.

The following questions will be answered in next month's issue:

(1) Where two gas engines in a pumping station, each with its own set of batteries, are so located as to permit consolidating the two sets of batteries, is it good practice to do this, and if so, how should they be connected?

(2) Is the practice of applying new joints to old rail in track to be recommended? What are its advantages?

(3) Does a sheet metal covering offer an effective fire protection for wooden bridges?

(4) Where it is desired to reduce or increase the speed of a belt driven pump a certain amount and this can be done only by increasing the size of the pulleys, how may the amount of the increase be determined?

(5) What is the proper method of giving first aid to a man overcome by heat?

(6) What investigation, if any, should be given to structural steel which has dropped while hoisting, or fallen from a car, to determine whether it may safely be used as originally planned?

(7) How should the timber be laid in a trucking floor with reference to the direction of the trucking?

(8) Why should electric wiring splices in buildings be soldered?

Brush on the Right of Way

Is there any objection to the presence of trees or brush on the right of way if they do not obscure the view along the track?

First Answer

Aside from the unsightly appearance of the right of way if brush is allowed to grow, there is a tendency to throw scrap into it instead of picking it up and saving it. If the brush is allowed to grow too close to the track it soon grows high enough to shade the track, thus preventing it from drying out quickly in the spring and after heavy rains. I do not believe that any road with money to spare for cutting brush, would allow it to grow because of its unsightly appearance. Trees on the right of way shade the track and cause bad track conditions unless they are fifty feet or more away from the track.

C. G. DELO,
Chief Engineer, Chicago Great Western, Chicago.

Second Answer

Where the right of way is not more than 100 ft. wide I believe it should be clear of trees and brush unless they are put there for a purpose, as they sometimes are. Since most large roads desire to mow their right of ways and keep them clean, brush and trees would be a hindrance to so doing. Large trees near the track may be blown on it and cause the derailment of a train during a storm at night. Trees on the right of way near highway crossings also obscure the view of the track for persons on the highway.

V. H. SHORE,
Section Foreman, Atchison, Topeka & Santa Fe, St. John, Kan.

Dusty Concrete Floors

How should a concrete floor be made to prevent it from "dusting?"

The phenomenon known as "dusting" of concrete floors is usually the result of too rapid evaporation of the water content in the first week or two after the floor is laid, too much mixing water, dirty aggregates, too fine sand, too much trowelling, or sprinkling dry cement on a freshly laid concrete floor.

Concrete hardens because of reactions between Portland cement and water. Down to a point lower than usually reached in construction work, the smaller the quantity of mixing water the stronger and harder will be the concrete. However, once the concrete is placed conditions change. The hardening process is slow and requires warmth and moisture. The cement content remains in a freshly placed concrete floor, but the water content, equally necessary for proper hardening, immediately begins to evaporate. If too much moisture is lost, concrete will attain only part of its potential strength

and hardens. Under such conditions the surface film of sand and cement may quickly work loose and cause dusting.

Loss of necessary moisture can best be prevented by keeping a concrete floor damp during its early hardening period. The day after the floor is laid, when it has hardened sufficiently to prevent pitting the surface, cover it with damp sand or earth and keep it damp by frequent sprinkling for a week or two. Small dikes of clay are sometimes built around sections of a floor, which is then flooded with water. This is often called "curing" a concrete floor, and the water thus used is called "curing water."

Keeping concrete damp the first ten days will increase its compressive strength 75 per cent and its resistance to abrasion 65 per cent. In other words, this one precaution, which costs practically nothing, will give over 65 per cent better value in the concrete. Three weeks protection will give still better results.

There is nothing that will give greater dividends in concrete floors than to use less water in mixing and more water in curing. Concrete roads are usually cured in this manner for two or three weeks, in spite of the fact that rain and snow will eventually replace any moisture that may be lost. Floors in buildings seldom get wet after being placed in service, and ample curing water should be provided.

In the case of a floor in which these precautions were not taken and which is, therefore, subject to "dusting," the trouble can sometimes be overcome by flooding the surface with water for a few days. The application of a sodium silicate (water glass) solution is an effective means of stopping the trouble. Scrub the floor thoroughly with clear water and allow it to dry. Mix one part of a commercial solution of water glass with three or four parts of water. Apply three or four coats of this solution evenly over the entire surface, letting each coat dry for 24 hours, and scrubbing the surface before applying the next coat. This solution penetrates the surface of the concrete, and coming in contact with the alkalies in the concrete, forms a very hard insoluble mineral glue. The part that remains on the surface is readily washed off.

In several cases the use of boiled linseed oil thinned with turpentine or gasoline has proven effective in stopping dusting trouble. This coating is best suited to old floors and darkens the surface somewhat. Paraffin either melted and applied hot or dissolved in naptha and applied cold has also been found effective. Washes of alum and soap solution (the Sylvester process) applied alternately, to a dry surface, the soap solution being hot, have been used in many cases.

The U. S. Bureau of Standards reports that very good results have been secured with magnesium fluosilicate and zinc sulphate treatments.

Cutting Rail in Place

Is it practicable to cut a rail with a cold chisel without removing it from track?

First Answer

A rapid way of cutting any length of rail desired without removing it from the track during the process is as follows: Spikes are drawn on the rail to be cut for a distance back of the cut sufficient to allow the rail to be lifted enough to slip an angle bar or short piece of rail under the base at the point of cutting. Thereupon a nick is cut in the flange on both sides at its outermost edge with the cold cutter. The angle bar is removed and the rail is respiked to the ties back of the cut. Three or four men then endeavor to bend the other end with their lining bars. The cold cutter is applied to the juncture of the flange and the web on the side towards which the free end is bent and one heavy stroke with a doublejack will usually sever the rail. In using this method for making a cut near the end of the rail, bolt a pair of joints on the end to form additional leverage for the bars. Five blows are the usual number for 90 lb. steel.

MILTON HARRIS,
Extra Gang Timekeeper, Southern Pacific.

Second Answer

Mark the rail fairly deep along the top of the base and web and up under the head and side of the head with a chisel (but do not cut across top of head) where the break is to be made. Pull the spikes on one or two ties near the cut so the rail can be sprung out slightly. Place a track jack in the middle of the track in a horizontal position with the lever up and the head of the jack at the edge of the chisel mark on the web of the rail. Place a block of sufficient length between opposite rail and foot of the jack to hold the jack solid. Now strain the rail out by working the jack lever a notch or two and strike the outside of rail with a heavy sledge near the cut. If the rail does not break at the first blow or two of the hammer, it may be necessary to cut it a little deeper and put a little more strain on the jack. The rail should also be chilled with a little cold water.

V. H. SHORE,
Section Foreman, Atchison, Topeka & Santa Fe, St. John, Kan.

Nut Locks

What is the purpose of a nut lock?

First Answer

The main purpose of a nut lock is to eliminate loose bolts in track, which it does by putting tension on the bolt so that it will take up friction and wear and tear on the head of the rail and the head of the splice bars. When properly made excellent results are obtained from the use of nut locks in eliminating the cost for labor and material in replacing bolts.

T. THOMPSON,
Roadmaster, Atchison, Topeka & Santa Fe, Joliet, Ill.

Second Answer

The purpose of a nut lock is to take up the slack in the bolt when for any reason it stretches. A bolt could be stretched and bent by a tendency of the rails, under certain conditions, to pull apart. Under different climatic or traffic conditions these same rails might close up and straighten the bolts, thereby leaving them loose unless the bolts were equipped with nut locks that functioned properly. A nut lock should also act as a cushion in case the bolt contracts or is subjected to a heavy shock. It should resist any tendency of the nut to back up on the bolt in cases where the nut might be a little large for the bolt.

G. A. LARSON,
Roadmaster, Chicago, Milwaukee & St. Paul, Chicago.

Third Answer

Equip a joint with the highest type of bolts and constantly maintain them, and a nut lock becomes unnecessary. But joints do not get such equipment or maintenance for economic and other reasons, hence the necessity for nut locks.

There are at least five good reasons for the use of nut locks on the general types of track bolts in use at present. These reasons are as follows:

(1) They prevent the nuts from turning back; (2) They preserve sufficient threads on the bolts to allow further tightening, for when a bolt in track that is not equipped with a nut lock becomes loose, vibration causes

battering of the threads coming in contact with metal of the angle bar at the edge of the bolt holes; (3) With nut locks, bolts can be loosened slightly in hot weather to allow the expansion and contraction of the rail without materially weakening the joint structure, and (4) nut locks reduce vibration, thereby reducing wear when the elongation of bolts and the wearing of friction points, etc., create looseness in the joint, and (5) they materially reduce the cost of joint maintenance.

J. J. NAVIN,
Supervisor, Pennsylvania System, Chicago.

Fourth Answer

The nut lock has been the subject of considerable discussion, particularly as to the advisability of using it at all. The arguments in favor of nut locks advance the idea that the nut lock is necessary to permit the proper expansion in rails, it being claimed that the proper expansion can not be provided without the nut lock. However, this is not proven in every case as we have stretches of track on our main line where nut locks have not been applied, on which we have experienced no trouble with expansion; neither have we been inconvenienced on account of loose bolts. In fact, nuts applied to bolts more than three years ago, without the nut lock, have not been disturbed by wrench or otherwise after being properly set since the bolts were inserted.

This indicates that the absence of the nut lock has not interfered in any way with the durability of the bolts or the nuts. It is my thought that if the nut is so constructed as to permit sufficient housing for the threads on the back portion of the bolt to be protected from the weather, we can get along very well without the nut lock. Under conditions where the nut lock is applied, the water soaks in through the nut lock and causes the threads to rust and corrode. We have laid considerable 90 lb. rail without installing nut locks on continuous joints and the bolts in these joints have not given us any great amount of trouble. From the foregoing you will note that I am of the opinion that the necessity for the nut lock in order to insure the expansion and contraction of rails is still unproved.

J. J. DESMOND,
Roadmaster, Illinois Central, Chicago.

Fifth Answer

Fundamentally, there is one and only one purpose of a nut lock in track work as distinguished from other kinds of work or uses in which nut locks are employed. Expressing this purpose in terms of the bolt upon which it is placed, it is that of assisting in keeping the bolt from getting loose, while expressing the purpose in terms of the joint, it is that of assisting in keeping the joint tight. While this is true, the part played or the part that should be played by a nut lock in preventing looseness as well as all the incidental benefits growing out of its use (often spoken of also as purposes) are entirely different matters.

When first introduced, it was the general opinion that looseness in bolts of a nature to require any attention at all, arose from the tendency of the nuts to reverse under the vibration and impact of passing trains. In this belief nut locks, while applied, of course, to prevent looseness, were designed only with the idea in mind of preventing the nuts from reversing. While the preventing of nuts from reversing is still a consideration in the use of nut locks (explaining perhaps why this is still the conception of the nut lock entertained by a surprisingly large number of maintenance men) and while it is customary to employ various devices in some kinds of track work only to keep nuts from reversing, it is now recognized that in track work in general, particularly that subjected to heavy traffic, no matter how securely nuts are held from reversing, the bolts will become loose. This looseness may arise from any one of several causes such as the stretching of the bolt under the wrench or traffic, from expansion and contraction, from the natural wear of joint surfaces by reason of corrosion, frictional wear, scale, bins, etc., and the inadequacy of the device to maintain bolts to the desired tension.

At the present time, therefore, the nut lock is to be considered as a device designed to assist in keeping the joint tight not only by exerting an outward force against the nut, by reason of its spring construction, sufficient to keep the nut from reversing, but also to take up the looseness which develops in the bolted parts and to absorb shocks transmitted to the bolt by the impact of passing trains. Incidentally, it also affords a protection to bolt threads which may be needed later and which might become injured by movements in the joint.

The degree to which this is accomplished, of course, will depend upon the nut lock used, and no nut lock can be expected to make up for a fundamental weakness in angle bars, bolts, etc. In preventing this looseness (by maintaining the bolt in proper tension) the results which may be expected from nut locks (often spoken of as purposes) are first, a higher standard of track maintenance at a reduced cost for both labor and material by reason of minimized bolt tightening and by the effect in reducing that wear in angle bars, bolts, rail ends, ties and ballast, that arises from loose joints and, second, a better track for rolling stock resulting from the condition where the track at joints more nearly approaches the condition of the track where the rail is continuous.

R. L. COCHRANE,
Office of Chief Engineer, System, Atchison, Topeka & Santa Fe, Chicago.

Pounds Per Thousand Gallons in Water Treatment

In referring to boiler waters, what is the correct relation between pounds per 1,000 gal., parts per 100,000 and grains per gallon?

The above expressions refer to different ways in which chemists record the amount by weight of a substance in a certain volume of water, from which it follows that an analysis of a water expressed in grains per gallon means (practically) that there are so many grains of that substance in every gallon of water considered, an analysis expressed in parts per 100,000 means that there are so many grains of that substance in every 100,000 cubic centimeters of water, while an analysis expressed in pounds per 1,000 gal. means that there are so many pounds of the substance in each 1,000 gal. of water, the mode of expression used being established by custom and convenience in the particular kind of work in question.

Since these analyses are all proportions of weights of substance to volume of water, one may be expressed in terms of the other, by remaining determining the relations. For all practical purposes these relations are as follows:

To convert grains per gallon to pounds per 1,000 gal., divide the number of grains given by 7.

To convert pounds per 1,000 gal. to grains per gallon, multiply the pounds given by 7.

To convert grains per gallon to parts per 100,000, multiply the grains given by 1.71.

To convert parts per 100,000 to grains per gallon, divide the parts given by 1.71.

To convert pounds per 1,000 gal. to parts per 100,000, multiply the pounds given by 12.

To convert parts per 100,000 to pounds per 1,000 gal., divide the parts given by 12.

Top Finishes for Concrete

When finishing the top of concrete work is it desirable to employ a somewhat richer mixture to aid in giving a good top surface with a trowel or float?

For ordinary work with concrete of reasonable density, it should not be necessary to use a richer mixture in order to obtain a good top surface. However, if the so-called sidewalk finish is desired, it may best be done according to the requirements and the specifications for masonry of the American Railway Engineering Association which read as follows: "Where sidewalk finish is called for on the plans, it shall be made by spreading a one-to-two mortar at least three-quarters of an inch thick and floating it to a small surface. This finishing coat shall be put on before the concrete has taken its initial set. For a walk, the surface shall be slightly roughed with a special tool or by sweeping with a coarse broom."

The use of the richer mixture ought not to cause any trouble as this practice is followed in the case of many of the special finishes placed on concrete work, either on the top surfaces or sides. In some cases, the materials used in these special finishes are entirely different than the body of the concrete. Such practices should be distinguished from the use of a wash or plaster of almost neat cement since this very readily leads into difficulty.

Fire in Creosoted Timbers

(*1*) *What is the best way to protect from fire creosoted ties or timbers stored along the tracks?*

(*2*) *If piles of creosoted ties or timbers have caught fire what is the best way to fight the fire?*

First Answer

These two questions may well be answered together. It is much better to take precautions to prevent a fire in piles of creosoted ties or timbers than to attempt to put out a fire once it has started. Good practice in protecting creosoted material from a fire is to pile it closely so as to leave a minimum of air spaces between the pieces. Then cover the top of the pile well with a thick layer of sand or earth and keep grass, weeds and brush clear of the pile on all sides. With these precautions properly observed there should be little danger of fire.

Insofar as the questions concern the quenching of a fire, the best answer is to state that the storage yard of every modern creosoting plant is not considered complete without a well distributed system of water pipes, adequately provided with fire hydrants. In the case of isolated piles of ties or timbers along the right-of-way where water is not available, the only practical method of fighting the fire is to throw on sand or earth in sufficient amounts to smother the flames.

Second Answer

When the fire has not gained too much headway and it is possible to get some loose dirt convenient, the fire can be put out by throwing the dirt onto it with a shovel, or any other means if there are no shovels at hand, scattering the dirt as it is thrown. Ties or timbers can also be put out by scattering them either by hand or a cable of any kind that the fire would not affect. Some loops of barbed wire taken from the right of way fence in case nothing better is handy can be used to pull the timbers apart. The ties or timbers should be separated from one another soon as possible, as any two left together will burn up but when separated the fire will go out as soon as the surplus oil on the outside burns off.

V. H. SHORE,
Section Foreman, Atchison, Topeka & Santa Fe.

American Railway Engineering Association

The association has received an invitation through the Brazilian Embassy at Washington, D. C., to be represented at the International Engineering Congress, which will be held at Rio de Janeiro in September, and it has appointed as delegates C. H. Crawford, manager Baldwin Locomotive Works and R. C. Crocker, locomotive car and marine superintendent, Leopoldina Railway, both of whom are resident in the convention city.

The proceedings of the 1922 convention are now on the press and it is expected that they will be ready for distribution early in August.

The Roadmasters' Association

At a meeting of the executive committee at the Hotel Statler, Cleveland, Ohio, on July 8, arrangements were perfected for the fortieth annual convention which will be held in that hotel on September 19-21. The program for the meeting, which was prepared at that time, follows:

TUESDAY, SEPTEMBER 19

10:00 A. M.—Convention called to order.
10:10 A. M.—Address of Welcome.
10:20 A. M.—Opening Address, C. A. Paquette, chief engineer, Cleveland, Cincinnati, Chicago & St. Louis.
10:40 A. M.—President's Address.
10:55 A. M.—Appointment of Committees.
11:00 A. M.—Report of Committee, Section Gangs vs. Extra Gangs for Maintenance Work.
12:30 P. M.—Adjournment.
2:00 P. M.—Report of Committee, Methods of Making Tie Renewals and Their Relation to Economical Track Maintenance.
3:30 P. M.—Paper, The Training of Section Foremen, D. C. Buell, director, Railway Educational Bureau, Omaha, Neb.
5:00 P. M.—Adjournment.
7:30 P. M.—Fortieth Anniversary Program.

WEDNESDAY, SEPTEMBER 20

9:30 A. M.—Report of Committee, The Non-Spacing of Joint Ties and the Non-Slotting of Joints.
11:00 A. M.—Paper, Influence of Track Maintenance on Signal Operation, J. A. Peabody, signal engineer, Chicago & North Western, Chicago.
12:30 P. M.—Adjournment.
2:00 P. M.—Report of Committee, Labor Saving Devices, G. W. Morrow, supervisor, New York, New Haven & Hartford R. R., New Haven, Conn., chairman.
3:00 P. M.—Paper, Morale, S. E. Shoup, engineering assistant to general manager, Kansas City Southern, Kansas City, Mo.
4:00 P. M.—Adjournment to inspect exhibit of Track Supply Association.
6:30 P. M.—Annual Dinner of the Roadmasters and the Track Supply Associations, Address by Elisha Lee, operating vice-president, Eastern Region, Pennsylvania System.

THURSDAY, SEPTEMBER 21

9:30 A. M.—Report of Committee, Economical Advantages and Methods of Maintenance of Motor Cars.

10:30 A. M.—Business Session, Election of Officers, Selection of meeting place for next convention.

1:30 P. M.—Inspection of Cleveland terminals and grade separation work.

Arrangements have also been completed for the exhibit of the Track Supply Association in rooms adjoining the convention hall and reservations have already been made for a large part of the space available. Indications point to the participation of a number of firms, equalling that of any previous years. Among those which have made reservations up to the present time are the following:

American Hoist & Derrick Company.....St. Paul, Minn.
American Valve & Meter Company.....Cincinnati, Ohio
Balkwill Manganese Crossing Company.....Cleveland, Ohio
Buda Company .....Chicago
Chicago Malleable Castings Company.....Chicago
Crerar, Adams & Co.....Chicago
Duff Manufacturing Company.....Pittsburgh, Pa.
Fairbanks, Morse & Co.....Chicago
Fairmont Gas Engine & Railway Motor Car Co.....
.....Fairmont, Minn.
Hauck Manufacturing Company .....New York City
Hayes Track Appliance Company .....Richmond, Ind.
Ingersoll-Rand Company .....New York City
Kalamazoo Railway Supply Company.....Kalamazoo, Mich.
Lundie Engineering Corporation.....New York City
Maintenance Equipment Company .....Chicago
Mudge & Company .....Chicago
National Lock Washer Company.....Newark, N. J.
P & M Company .....Chicago
Pocket List of Railroad Officials.....New York City
Positive Rail Anchor Company.....Marion, Ind.
Rail Joint Company.....New York City
Railroad Supply Company .....Chicago
Railway Purchases & Stores.....Chicago
Ramapo Iron Works .....Hillburn, N. Y.
Reade Manufacturing Company .....Jersey City, N. J.
Reliance Manufacturing Company .....Massillon, Ohio
Sellers Manufacturing Company .....Chicago
Simmons-Boardman Publishing Company....New York City
Stevens Metal Products Company.....Cleveland, Ohio
Union Switch & Signal Company.....Swissvale, Pa.
Verona Tool Works .....Pittsburgh, Pa.
Warren Tool & Forge Company.....Warren, Ohio
William Wharton Jr. & Co., Inc.....Easton, Pa.
Wood Shovel & Tool Co.....Piqua, Ohio
Woolery Machine Company .....Minneapolis, Minn.
Wyoming Shovel Works .....Wyoming, Pa.

SEEK BETTER WARNINGS AT CROSSINGS—C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul, in an effort to reduce accidents at railway crossings, has addressed a letter to public service and highway commissions of a number of states in the middle west, calling attention to the division of responsibility between the railways and the highway authorities for the installation of adequate warning signs at grade crossings and suggesting that the public authorities take the necessary steps to cause the removal of all unauthorized signs from public highways and prevent the placing of new signs of this character so that grade warning signs at grade crossings will stand out more conspicuously.

MEMORIAL TO DAVID THOMPSON—The Canadian Pacific, in conjunction with the Hudson Bay Company, is preparing to erect a memorial building on the shores of Lake Windermere, B. C., as a tribute to David Thompson who explored and surveyed a large part of Western Canada between 1784 and 1826. The site of the memorial, which will be built in the form of a Hudson Bay fort with stockades and bastions, is the place where Thompson established the first white man's trading post west of the Rocky mountains and made the first accurate records and surveys. The formal opening of the memorial building is arranged for September 1.

The Material Market

THE MATERIAL market is in an exceedingly uncertain state because no industry can be in normal condition in the face of the prevailing coal and railroad strikes. While railroad purchases have continued on an encouraging basis, there has been some reduction in the demand from many other fields. There has been a noticeable decrease in the demand for structural steel, while the approaching end of the most active season of automobile manufacture has caused a falling off in the requirements for automotive materials. These reductions in demand, however, have been moderate and with some falling off in production as a consequence of the labor shortage and the growing scarcity of coal, the relation between supply and demand has not changed appreciably and the prices for steel items have changed but little, as will be noted in the table below. Attention is called to the change in the differential for Chicago prices over the Pittsburgh base. As a consequence of the 10 per cent cut in freight rates this is now 34 cents per 100 lb. instead of 38 cents.

	Prices in Cents Per Pound			
	June 20		July 20	
	Pittsburgh	Chicago	Pittsburgh	Chicago
Track spikes	$2.25	$2.50 to $2.63	$2.25	$2 59 to $2.69
Track bolts	3.00	3.50 to 3.63	3.00 to $3.25	3.59 to 3.69
Angle bars	2.40	2.40	2.40	2 40
Tie plates, steel	$1.75 to 2.00	1.85	2.00 to 2.25	1.85
Tie plates, iron		1.85		1.85
Plain wire	2.25	2.63	2.25	2.59
Wire nails	2.40 to 2.50	2.78 to 2.88	2.40 to 2.50	3.74 to 2 84
Barbed wire, galv.	3.05 to 3.15	3.43 to 3.53	3.05 to 3.15	3.39 to 3.49
C. I. pipe, 6 in. or larger, per ton		46.60		46.70
Plates	1.60 to 1.80	1.75 to 1.85	1.60 to 1.80	1.75 to 1.85
Shapes	1.60 to 1.80	1.75 to 1.85	1.60 to 1.80	1 75 to 1.85
Bars	1.60 to 1.75	1.75 to 1.85	1.60 to 1.80	1.75 to 1.85

A like situation prevails in the scrap market. There has been little change, although what modifications there are have been upward.

	Prices Per Gross Ton at Chicago	
	June	July
Relaying rails	$22.50 to $27.50	$22.50 to $27.50
Rerolling rails	15.00 to 15.50	16 00 to 16.50
Rails less than 3 ft. long	15.75 to 16.25	17.50 to 18.00
Frogs and switches cut apart	14.50 to 15.00	15.00 to 15.50
	Per Net Ton	
No. 1 railroad wrought	12.50 to 13.00	13.50 to 14.00
Steel angle bars	13.50 to 14.00	14.75 to 15.25

The lumber business apparently has passed the normal summer peak so that the demand is gradually falling off. However, with corresponding reductions in production the relation between orders and shipments have not changed to any great extent. The aggregate figures since the first of the year, compiled by the National Lumber Manufacturers' Association, up to and including the week ending July 8 were as follows: Cut, 5,422,000,000 ft. B. M.; shipment, 5,517,000,000 ft. B. M.; ordered, 5,896,000 ft. B. M. Current prices for Southern pine and Douglas fir lumber have changed but little from quotations of a month ago.

Southern Mill Prices		
	June	July
Flooring, 1x4, B. and B. flat	$46.75	$46.60
Boards, 1x8, 14 and 16, No. 1	31.95	31.65
Dimension, 2x4, 16, No. 1	25.75	26.30
Dimension, 2x10, 16, No. 1, common	25.40	25.45
Timbers, 4x4 to 8x8, No. 1	24.00	24.40
Timbers, 3x12 to 12x12, No. 1	29.00	.....
Douglas Fir Mill Prices		
Flooring, 1x4, No. 2, clear, flat	37.00	39.00
Boards, 1x6, 6 to 20, No. 1, common	12.50	12.50
Dimension, 2x4, 16, No. 1, common	16.50	16.50
Dimension, 2x10, 16, No. 1, common	16.50	16.50
Timbers, 6x6 to 8x8, No. 1, common	17.00	17.00
Timbers, 10x10 to 12x12, rough	18.00	18.00

After advances in Portland cement prices effective June 6 ranging from 10 to 20 cents per barrel, new price schedules were issued on July 3 indicating reductions of from 2 to 6 cents a barrel. Current prices for cement in carload lots, not including package, are given below:

Pittsburgh	$2.09	Milwaukee	$2.22
Detroit	2.33	Minneapolis	2.29
Chicago	2.05	Davenport	2.28
Duluth	2.04	Cincinnati	2.39

General News

The Northwestern Region of the Pennsylvania issued the first number of its "Pennsylvania News" on July 1. This paper, which is an eight-page tabloid size newspaper, with four columns to the page, will be published every two weeks and distributed to each of the 18,500 employees of that region.

A bill has been introduced by the Minister of Railways and Harbors of the Union of South Africa providing for the construction of 21 new railway lines, mostly in agricultural districts, with a total length of 851 miles, costing about $20,000,000.

During the year 1921 approximately $20,000,000 was charged to the loss and damage account of the railroads by the Freight Claim Division of the American Railway Association as the outcome of losses and damages to perishable commodities, not including live stock.

The Chicago, Burlington & Quincy pensioned 47 employees last week, nine of whom have been in continuous service of the company for over 50 years, 25 for more than 40 years and 16 from 22 to 40 years. Of this number 9 were track and 5 bridge and building men.

A disastrous railway fire occurred at Baltimore on the afternoon of July 2 when lightning struck the Locust Point terminal of the Baltimore & Ohio, causing damage to grain elevators and contents as well as to loaded freight cars to the extent of more than $4,000,000. The estimated original cost of the buildings and plant itself is about $2,500,000, of which part was covered by insurance.

An automobile accident prevention campaign is to be conducted by the National Bureau of Casualty & Surety Underwriters to reduce the rapidly increasing number of casualities from this source. The bureau, which comprises representatives of 23 of the leading stock casualty insurance companies, reports that during 1921 there were 12,500 deaths, or one every 42 minutes night and day, and that over 300,000 other injuries occurred from automobile accidents in the United States.

Returns for May show that the Class I railroads of the United States received a net operating income representing an annual return of 4.36 per cent on their tentative valuation as compared with an annual rate of return of 2.6 per cent in May of last year and of 3.93 per cent in April of this year. The report further shows that 56 railroads, of which 27 were in the eastern, 2 in the southern, and 27 in the western district, encountered operating deficits in May as compared with 59 in April.

Maintenance of way forces on the Pennsylvania had an unusual demand made upon their time early in July in being required to build about one and a half miles of wagon road to enable consignees of watermelons and other perishable freight at New York City to reach delivery tracks on Newark Meadows, five miles from New York City, the destruction of a drawbridge by a steamer on June 22 having made the regular highways impassable, and heavy rains having prolonged the condition. The cost of road building was about $15,000.

A report of the Geological Survey on coal production indicates that for the thirteenth week of the strike (June 26 to July 1), the output in coal was 5,207,000 tons of bituminous and 25,000 tons of anthracite, or a total of 5,232,000 tons of coal, which compares with a total of 9,530,000 tons in the corresponding week of 1921 and 12,064,000 tons in 1920, a year of active business. Considering anthracite and bituminous coal as a common source of supply, this report shows the present production to be running from 5,000,000 to 6,000,000 tons behind normal.

The Service Letter Law of Oklahoma, requiring public service corporations and the like to furnish an employe with a service letter giving the length of service the employee has rendered, without other details calculated to reflect upon the man, has been upheld by the United States Supreme Court in a case where a switchman on the Rock Island, having received personal injuries and been refused re-employment on the grounds of physical incapacity, received a service letter which inferred that he had been dismissed on account of responsibility for the incident causing his injury, a reflection which made it difficult to obtain other employment.

An indication of the amount of business now being handled by railroads is given in the report of the American Railway Association on car loading. This report shows the number of cars loaded with revenue freight for the week ended July 1, the last week before the 10 per cent reduction in freight rates took effect as well as the last week before the shopmen's strike, was 876,896 which was an increase of over 100,000 as compared with the corresponding week in 1921 and only 14,725 less than the loading for the corresponding week of 1920, the reason for which is indicated by the fact that in May of this year coal loading was 98,286 cars less than in 1920.

In the interest of the careful crossing campaign, the New York Central is circulating a standard speech concerning accidents at grade crossings. This speech takes four minutes to deliver and has already been read at sessions of commercial organizations, rotary clubs, automobile clubs, motion pictures, etc. This address shows that approximately 1,800 persons are killed on railroad grade crossings each year and about 5,000 sustain painful and crippling injuries. It further states that in the last 30 years while the country's population has increased only 68 per cent, crossing accidents have increased 345 per cent and injuries 652 per cent, also that 75 per cent of the persons killed and injured at grade crossings have been occupants of automobiles.

The eleventh annual safety congress, which is promoted by the National Safety Council, a co-operative non-commercial organization of men, industries and communities interested in the prevention of accidents, will be held in Detroit, Mich., from August 28 to September 1. This conference in the past has brought together 3,000 or more persons who are actively engaged in safety work in both the United States and Canada. Invitations will be sent to 15,000 executives and safety workers this year and a large attendance is expected. Complete discussions of the various phases of industrial and public safety will be conducted at the meetings of the 20 different sections into which the council's activities are divided. These meetings will cover safety problems in a wide variety of fields. The steam railroad section, which will hold sessions on Tuesday and Wednesday, August 28 and 29, will cover subjects including "Safety and Publicity," "Accident Prevention from the Standpoint of the Operating Department," and "Report of Progress on the Careful Crossing Campaign."

Personal Mention

General

F. D. Davis, who was promoted to superintendent on the Pennsylvania, as noted elsewhere, was born at Baltimore, Md., on March 21, 1885, and was educated at the Baltimore Polytechnic Institute. He entered the service of the Pennsylvania Railroad in June, 1903, as a levelman on the Delaware division, becoming a rodman on the Baltimore division in March, 1905, transitman in the office of the principal assistant engineer maintenance of way in June, 1906, and assistant supervisor on the Central division the following June, from which division he was transferred to the Cresson division in November, 1909, and again to the New York division in May, 1910. On June 16, 1913, he returned to the Cresson division, having been promoted to supervisor. He was subsequently transferred to the Sunbury division in September, 1916, and to the Trenton division in November, 1917. On April 1, 1918, he was appointed assistant freight trainmaster, from which position he was promoted to division engineer on March 1, 1920, remaining in this position until his recent promotion.

F. D. Davis

Engineering

B. Blowers, supervisor on the Erie, with headquarters at Hornell, New York, has been promoted to assistant division engineer of the Rochester division with headquarters at Rochester, New York, to succeed **John Gray,** who has been transferred to the Wyoming division with headquarters at Dunmore, Pa., to succeed **R. G. Wilson,** resigned.

R. S. Stewart, supervisor of the Philadelphia division of the Pennsylvania, with headquarters at Earnest, Pa., has been promoted to division engineer of the middle division, with headquarters at Altoona, Pa., effective July 1, to succeed **N. B. Pitcairn,** who has been transferred to the New York division, with headquarters at Jersey City, N. J., to succeed **F. D. Davis,** promoted to superintendent of the Norfolk division at Cape Charles, Va.

William G. Morgan, assistant engineer on the Kansas City Southern, with headquarters at Pittsburg, Kan., has been promoted to the re-established position of division engineer of the Kansas City terminal division, with headquarters at Kansas City, Mo., effective July 1. Mr. Morgan was born on November 25, 1884, at Magnolia, Ark., and was educated at Arkansas University, from which he was graduated in May, 1910. He entered railway service in September of the same year as a rodman on the Kansas City Southern, and successively thereafter served as rodman at various points, as an inspector on bridge construction, river bank protection and as a transitman, assistant engineer and roadmaster, all on the Kansas City Southern, until his recent promotion as division engineer.

H. Marshall, a draftsman in the maintenance of way department of the Southern Pacific at San Francisco, Cal., has been promoted to chief draftsman and office engineer, with the same headquarters, to succeed **H. I. Benjamin,** who has been promoted to assistant division engineer of the Portland division with headqarters at Portland, Ore., in place of **H. A. Hampton,** promoted Mr. Benjamin entered the service of the Southern Pacific in October, 1908, as a draftsman in the maintenance of way department at San Francisco, Cal., and held this position until January, 1916, when he resigned to enter business for himself. Reentering the service of the Southern Pacific in May, 1918, as a draftsman in the same department from which he had resigned, he served as a draftsman until April, 1920, when he was promoted to chief draftsman. He became office engineer a year later.

William P. Wiltsee, assistant engineer on the staff of the chief engineer of the Norfolk & Western, with headquarters at Roanoke, Va., has been promoted to principal assistant engineer, with the same headquarters. Mr. Wiltsee was born on May 30, 1878, at Cincinnati, Ohio, and entered railway service in 1895 as a rodman for N. D. Burke, consulting engineer at Cincinnati, and was engaged alternately in municipal and railroad work until 1899. During the following year he served as draftsman and instrumentman for the United States government on river and harbor work and in 1900 was appointed assistant engineer on construction and maintenance on the Cincinnati, Portsmouth & Virginia. Mr. Wiltsee entered the service of the Norfolk & Western in 1901 as a draftsman in the office of the engineer maintenance of way and in 1902 was promoted to chief draftsman in the office of the engineer of construction. From 1903 to 1912 he served as assistant engineer on branch line development in the coal fields, and in the latter year was placed in charge of extensive tidewater improvements at Norfolk and also on other work on the eastern end of the road. He was appointed assistant engineer in the office of the chief engineer in charge of engineering matters connected with maintenance of way, water supply, fuel stations, etc., in 1916, and held this position at the time of his recent appointment. Mr. Wiltsee is a past president of the Roadmasters' and Maintenance of Way Association and a director of the A. R. E. A.

William P. Wiltsee

J. G. Bloom, whose promotion to the newly created position of engineer maintenance of way, of the Chicago, Rock Island & Pacific system, with headquarters at Chicago, was reported in the June issue, was born in Ohio on November 25, 1869, and studied engineering at Ohio State University. Immediately following his graduation in 1889, he entered railway service as a chainman on the Pennsylvania at Cincinnati, Ohio. After a few months, he left railway service and in the spring of 1890 became associated with the Kenova Land Association as an assistant engineer at Kenova, W. Va., but re-entered railway service that fall as an assistant supervisor on the Norfolk & Western at Crewe, Va., where he remained until April, 1892. He was appointed an assistant engineer on the Baltimore & Ohio Southwestern on the latter date with headquarters at Cincinnati, Ohio, on which road he served in this capacity until November, 1895, as a division engineer at Flora, Ill., until June, 1896, as principal assistant engineer at Cincin-

J. G. Bloom

nati, Ohio, until February, 1900, and thereafter as division engineer at Chillicothe, Ohio, and later at New Castle, Pa., until June, 1903, when he entered the service of the Chicago, Rock Island & Pacific as district engineer, with headquarters at Topeka, Kan. Thereafter he served as district engineer until July, 1905, as engineer maintenance of way of the Southwestern and Choctaw district at Topeka until February, 1907, and again as district engineer until December, 1909, when he left railway service to become president of the Southern Ballast Company at Denison, Texas. He was engaged in this work until July, 1912, and then as superintendent of construction of the John F. Stevens Construction Company, New York, until October, 1914, when he re-entered the service of the Chicago, Rock Island & Pacific. Thereafter he was engaged in valuation work with headquarters at Chicago until July, 1916; as superintendent of the Amarillo division with headquarters at Amarillo, Texas. until August, 1918; as superintendent of the Louisiana division with headquarters at Eldorado, Ark., until May, 1921; and as division engineer of the Nebraska-Colorado division with headquarters at Fairbury, Neb., until May 15, 1922, when he was promoted to engineer maintenance of way, system.

Henry C. Estee, assistant valuation engineer of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn., has been appointed office engineer in the chief engineer's offices of the Chicago & North Western, with headquarters at Chicago, succeeding **W. R. Kettering,** whose promotion to auditor of capital expenditures was noted in last month's issue. Mr. Estee was born April 16, 1875, in Illinois and graduated in civil engineering from the University of Illinois in 1896, following which he served consecutively as rodman, inspector and instrumentman on the Illinois & Mississippi Canal until 1900 when he entered railway service as an instrumentman on the Chicago & North Western. He was promoted to assistant engineer a few years later and held the position until 1913, since which he served in the consecutive capacities of assistant engineer and assistant valuation engineer on the Chicago, St. Paul, Minneapolis & Omaha until June 12, 1922, when he received his recent appointment.

Track

W. H. Henderson has been promoted to roadmaster on the Canadian National with headquarters at Ottawa, Ontario, to succeed **O. Ogden,** deceased.

J. W. Slater has been promoted to roadmaster on the Outlook subdivision of the Moose Jaw division, of the Saskatchewan district of the Canadian Pacific, with headquarters at Outlook, Sask., to succeed **A. Anderson,** who has been transferred to the Moose Jaw division of the Saskatchewan district with headquarters at Assiniboia, Sask., to succeed **T. Tapsey,** appointed section foreman.

O. L. Fisher, a rodman on the Pennsylvania terminal division of the Pennsylvania, with headquarters at Philadelphia, has been promoted to assistant supervisor on the Atlantic division with headquarters at Camden, N. J., effective July 1, to succeed **J. M. Fox,** who has been transferred to the Baltimore division with headquarters at Baltimore, Md., to succeed **J. C. White,** who has been promoted to supervisor of the Schuylkill division, with headquarters at Norristown, Pa., to succeed **R. Swenk,** transferred to the Philadelphia division, with headquarters at Middletown, Pa., to succeed **R. S. Stewart,** promoted to division engineer of the Middle division, as noted elsewhere.

S. Arthur Taylor, recently promoted to supervisor on the Southern with headquarters at Lincoln City, Ind., was born on November 25, 1877, at Burnside, Ky., and entered railway service on October 4, 1895, as a section laborer on the Cincinnati, New Orleans & Texas Pacific, where he remained until January, 1900, when he became a locomotive fireman. He re-entered track service in March, 1903, and was promoted to section foreman at Somerset, Ky., in January, 1907, where he remained until his transfer to McKinney, Ky., in January of the following year. Leaving this position in June, 1911, to enter the service of the Southern he was employed as section foreman at Salvisa, Ky., until February 13, 1920, when he was transferred to Shelbyville, Ky., to the position he held at the time of his recent promotion.

Everett E. Earl, whose promotion to roadmaster of the Klamath district of the Southern Pacific, with headquarters at Klamath Falls, Ore., was noted in the July issue, was born on May 23, 1888, at Drain, Ore. He entered railway service in February, 1905, and served consecutively in the engineering department of the Southern Pacific as rodman, levelman and transitman on location in Oregon, California, Nevada and Mexico, until April, 1914, when he was appointed instrumentman on drawbridge construction. From April, 1917, to September, 1921, he then served as assistant engineer on maintenance of way work, as office engineer and as a supervisior of reballasting in the Sacramento canyon. Promoted to acting roadmaster in September, 1921, he held this position until his recent promotion.

Grover Kidd, whose promotion to track supervisor on the Southern, Lines West, with headquarters at Oakdale, Tenn., was noted in the July issue, was born on September 14, 1885, at Pine Knot, Ky. Mr. Kidd entered railway service July 1, 1901, as a track laborer, which position he held until 1903, when he was transferred to the bridge and building department as a bridge laborer. In 1905 he was promoted to assistant gang foreman and in 1908 was promoted to section foreman. He served as track supervisor from February, 1916, to March, 1918, and on the latter date left railway service. Returning on August 1, 1921, he continued as extra gang foreman, until his recent promotion. All of his railway experience has been obtained in the employ of the Cincinnati, New Orleans & Texas Pacific and the Southern railways.

F. S. Purdy, whose promotion as inspector of track and roadway of the Atchison, Topeka & Santa Fe, coast lines, with headquarters at Los Angeles, Cal., was noted in last month's issue, entered railway service as a brakeman in the construction department on the eastern extension of the Iowa Central in Illinois in 1887, following which he served as section foreman until April 15, 1891. On April 28, 1891, he entered the service of the Atchison, Topeka & Santa Fe as a section foreman, and held this position for four years, when he became assistant foreman on a construction gang. After serving three months in this capacity he was promoted to general foreman, and was thus engaged for 12 years with the exception of five months when he held the position of locomotive fireman. In 1906 he was promoted to roadmaster of the Second district of the Albuquerque division, and held this position until his transfer to Los Angeles, Cal., six months later. In November, 1921, he was promoted to acting inspector of track and roadway to assist J. E. McNeil, following the latter's injury in a motor car accident. Upon Mr. McNeil's death, Mr. Purdy was then made inspector on track and roadway.

F. S. Purdy

F. C. Blogett, whose promotion to construction roadmaster on the first district of the Arizona division of the Atchison, Topeka & Sante Fe was noted in the July issue, was born on April 10, 1880, at Marshalltown, Iowa. After spending two years in elementary engineering study he entered military service as an artificer in Company C, 35th Regiment, Infantry, United States Volunteers, with which he remained during the Philippine Rebellion. Mr. Blogett was thereafter employed on various construction work until 1907, when he was appointed section foreman on the Tucson division

of the Southern Pacific. He left this road in 1910 to become a section foreman on the Atchison, Topeka & Santa Fe, where he was promoted to roadmaster of the Arizona division in 1912, a position which he held until the time of his recent promotion, with the exception of the period from August, 1917, to October, 1919, when he served over-seas as a captain in the air service during the World War.

Obituary

Samuel Borden Rice, engineer maintenance of way of the Richmond, Fredericksburg & Potomac, with headquarters at Richmond, Va., died at his home in Ashville, Va., June 26. Mr. Rice was born on March 18, 1849, at Berkeley, W. Va., and entered railway service on November 22, 1865, as a laborer on the Richmond & Petersburg, which position he held until May, 1866, when he became a lumber checker. During the summer of 1866 he served as a bridge laborer on the Richmond, Fredericksburg & Potomac and later worked in various capacities in connection with bridge construction at Richmond for the same road and the Richmond & Petersburg Connection Company. He was out of railway service from 1867 to 1868 and from the latter date to May, 1869, served as bridge carpenter on an extension of the Chesapeake & Ohio from Covington to White Sulphur Springs. In 1875 Mr. Rice was promoted to foreman of bridges and in August, 1880, was promoted to master carpenter, which position he held until 1889, when he was promoted to roadmaster. In 1907 he was promoted to engineer maintenance of way, the position he held at the time of his death.

Samuel Borden Rice

Gamble Latrobe, general superintendent of the Southern division of the Pennsylvania, and at one time division engineer of the Baltimore division, died at Atlantic City June 21. Mr. Latrobe was born on January 21, 1866, at Baltimore, Md., and after receiving a private school education entered the service of the Baltimore & Ohio as a rodman on the construction of the Philadelphia division, a position he left on July 31, 1887, to become a levelman on construction with the Pennsylvania. On May 28, 1888, he entered the service of the Philadelphia & Reading at Williamsport, Pa., and continued in the employ of that company until October 2, 1889, when he returned to the Pennsylvania at Altoona, Pa., where on February 1, 1890, he was appointed assistant supervisor. He was promoted to supervisor on January 1, 1895; was advanced to division engineer of the Baltimore division in April, 1902, and on March 11, 1908, was promoted to acting general agent and superintendent at Baltimore, since which he was consecutively general agent of the Philadelphia, Baltimore & Washington and the Northern Central, and superintendent of the Baltimore division of the Northern Central, and general superintendent of the P. B. & W.

Gamble Latrobe

Construction News

The Atchison, Topeka & Santa Fe, in conjunction with the city of Kansas City, Kan., is preparing plans for the south approach and main section of a viaduct at Goddard avenue. The construction program for the north approach has not been completed, pending negotiations with other railroads.

This road is contemplating extensive improvements to freight facilities at Dallas, Texas, to include the construction of a new reinforced concrete warehouse and office building, 60 ft. by 240 ft., with one 8 ft. by 240 ft. platform, and a 60 ft. by 60 ft. reinforced concrete warehouse addition to be equipped with an 8 ft. by 60 ft. closed and a 30 ft. by 150 ft. open platform.

The Baltimore & Ohio has awarded a contract to the Kelly-Atkinson Construction Company, Chicago, for the erection of plate girder bridges over the public road south of Painesville, Ohio, and the Black River at Elyria, and has awarded a contract to the American Bridge Company for the fabrication and erection of a three span girder bridge near Mitchell, Ind. The company has also placed a contract with the Pittsburgh Construction Company, Pittsburgh, Pa., for the erection of a two span girder bridge in Cumminsville, Ohio.

The Buffalo, Rochester & Pittsburgh has awarded a contract to the Ogle Construction Company, Chicago, for the construction of a 1,200-ton frame coaling station at Rickers, Pa., to include duplex hoisting equipment with two-way buckets and complete sanding facilities.

The Canadian National has awarded contracts for water supply improvements on the Grand Trunk Pacific in western Canada as follows: The construction of dams at Pope, Man.; Raymore, Sask.; Maryfield, Sask.; Mecheche, Alta.; and Conquest, Sask., to W. A. Dutton, Winnipeg, Man.; the construction of a dam at Wiseton, Sask., to the Northern Construction Company, Winnipeg, Man., and the construction of a dam at Rama, Sask., to C. G. Anderson, Norwood, Man.; the construction of pipe lines at Wiseton, Sask.; Rama, Sask.; Raymore, Sask.; and Maryfield, Sask., to Green & Elsasser, Winnipeg, Man.; the construction of a pipeline at Pope, Man., to G. M. Irwin, Stonewall, Man.; a pipeline at Mecheche, Alta., to the Jamieson Construction Company, Edmonton, Alta., a pipeline at Tilney, Sask., to Riley & Reed, Patience, Alta., and 10,000 ft. of pipe line at Lloydminsted, Ala., to Simpson & Shillington, Winnipeg, Man. This company has also awarded contracts to Gibbs Bros., Lumsden, Sask., and to Rossa & Wickstrand, Saskatoon, Sask., respectively, for a line revision on the boundary subdivision near Lampman, Sask., and for a connection between the Craik and Riverhurst subdivisions at Regina, Sask.; and has awarded a contract to the Ideal Fence & Spring Co. of Canada, Winnipeg, Man., for approximately 50 miles of fencing on the Oakland, Man., subdivision.

The Canadian Pacific closed bids on July 17 for the construction of a new pier at its Pacific terminal in Vancouver harbor, this pier to be 850 ft. long and 330 ft. wide, and to cost approximately $2,000,000. Bids call for the completion of the structure by September 30, 1923.

The Canadian Pacific has completed plans for branch lines, construction to include the closing of the existing gap in the Weyburn, Sask.-Lethbridge, Alta., line; the grading of the first 60 miles east from Consul, Sask.; the equipping for traffic of the first 50 miles of the line from Lanigan, Sask., to Naicam and the completion of the 12.5 mi. line extending north from Russel, Man.

The Chesapeake & Ohio has awarded a contract to Fairbanks Morse & Co., Chicago, for the construction of an 800-ton reinforced concrete coaling station, sand dryer and cinder handling plant at Clifton Forge, Va., this station to provide pockets for three kinds of coal, to be equipped with a coal crusher and screen, to include two 200-ft. cinder pits and an overhead traveling crane system of cinder hand-

ling and to cost approximately $92,000. This company has also awarded to the same contractor a contract for the construction of a 500-ton reinforced concrete coaling station, sand dryer and cinder handling plant at Thurmond, W. Va., to cost approximately $52,600. This company has awarded a contract to the Fairfield Engineering Company, Lancaster, Ohio, for the construction of a 300-ton frame coaling station at Charlottesville, Va., to cost approximately $15,500, and will erect a 250-ton frame coaling station at Raleigh, W. Va., with company forces at an approximate cost of $18,000. This company has awarded a contract to J. T. Nuckols, Richmond, Va., for the construction of a 52-ft. by 523-ft. reinforced concrete freighthouse at Norfolk, Va., to replace a structure destroyed by fire, the new structure to cost approximately $160,000; and is undertaking jointly with the State Highway Department of Virginia the elimination of a grade crossing at Longdale, Va., by the construction of a subway to be built by Major Brothers & Co., Clifton Forge, Va., at a cost of approximately $20,000.

The Chicago, Burlington & Quincy, reported in the June issue as accepting bids for the construction of a five-stall roundhouse at Council Bluffs, Iowa, has awarded the contract to the Home Builders, Omaha, Neb. This road has also awarded a contract for the construction of a power house at Plattsmouth, Neb., to the Jones Engineering Company, Chicago.

The Chicago, Burlington & Quincy called for bids during the month for the construction of a two-story brick addition to a freight house at Burlington, Iowa, and has awarded a contract to the Great Lakes Construction Company, Chicago, for the construction of a power plant at Aurora, Ill. This company has awarded a contract to G. A. Johnson & Sons, Chicago, for the construction of a 6-stall engine house at Rock Island, Illinois, and called for bids during the month for the construction of one-story brick passenger stations at Fort Morgan, Colo., and Hardin, Mont.

This road has completed surveys for and may undertake next year the construction of a 17-mile cut-off which it has had under consideration for several years and has finally authorized between Frederick, Ill., and Vermont, the work to involve heavy grade revision and probably to include four tunnels This company is making surveys for a 45-mile extension northerly from Casper, Wyo., to the Salt Creek and Teapot oil fields.

The Chicago, Rock Island & Pacific is contemplating the construction of a freight station at Omaha, Nebraska, to cost in the neighborhood of $200,000.

The Cleveland, Cincinnati, Chicago & St. Louis has been ordered by the Illinois Commerce Commission to construct a viaduct over its tracks and those of the Lake Erie & Western at Bloomington, Ill. This company noted in the June issue as preparing to replace four steel bridges at various points on its line, has awarded contracts to the Walsh Construction Company, Davenport, Ia., for the sub-structure work on three bridges, the fourth not requiring such work.

The Illinois Central is contemplating the improvement of its freight facilities at Indianapolis, Ind., the work to include the construction of a freight handling platform, the paving of the drive way and the laying of two tracks. It called for bids during the month for the construction of interlocking plants at Peotone, Ill., and Manteno to involve a total expenditure in excess of $20,000. This company has awarded a contract to G. A. Johnson, Chicago, for and is now undertaking the construction of an addition to the hospital at Chicago, to cost approximately $250,000. It has awarded a contract to the Railway Water & Coal Handling Company, Chicago, for the construction of a $20,000 water supply line at Kankakee, Ill., mentioned in the July issue.

The Kansas & Oklahoma has located and is preparing to build an extension to its present line northwesterly through Hugoton, Kan., with the plan in view of eventually building to Trinidad, Col., a preliminary route already having been established as far as the Colorado state line.

The Louisiana & Arkansas was to close bids on July 31 for the construction and equipment of a locomotive repair shop at Stamps, Ark.

The Minneapolis, St. Paul & Sault Ste. Marie will rebuild its 16-stall roundhouse recently destroyed by fire at Gladstone, Mich., although plans concerning the date of rebuilding and the type of structure are as yet indefinite.

The Missouri Pacific called for bids during the month for the construction of a considerable extension to its car repair shed at Sedalia, Mo.

The Missouri, Kansas & Texas noted in the February issue as having prepared plans for large terminal facilities at Denison, Texas, to include a 22-stall roundhouse, shop, power plant, storehouse and other facilities, and noted in the July issue as having called for bids on this work, has awarded a contract to Bowie, Lydon & Co., Inc., Chicago, for the construction of the buildings, to cost approximately $450,000. This company is reported to have awarded a contract to the A. McKenzie Company for the construction of a two story brick and concrete freight house, 58 ft. by 400 ft. at Waco, Texas, and called for bids during the month for the construction of freight houses at Wichita Falls, Texas, and Fort Worth.

The Pennsylvania called for bids during the month for the elevation of tracks from Everett street to south of White Horse Pike, Camden, N. J.

The Pennsylvania received bids during the month for the construction of a double-track girder bridge with reinforced concrete floor over the state highway north of State Road Station, Del., which work will include about 960 cu. yd. of foundation and channel excavation, 1,200 cu. yd. masonry, and 5,000 cu. yd. of embankment; and called for bids for the elevation of tracks and the elimination of grade crossings from the Ft. Wayne connection at Anderson street to Thirtieth street bridge (Northside) Pittsburgh, Pa., and for the construction of a reinforced concrete arch bridge over the tracks of the Indiana branch, at a point south of Reed station, Pa. This company is also receiving bids for the construction of an undergrade bridge on line of Station avenue at Cornwells, Pa., the structure to have a 27 ft. roadway and a 6 ft. sidewalk.

The Union Pacific has authorized and will undertake at the earliest possible date the construction of 20.47 miles of second track on the Oregon Short Line through Glenns Ferry, Idaho. The timber treating plant which this company was reported in the June issue as planning to construct at The Dalles, Oregon, at an expenditure of approximately $500,000, has been authorized and a contract for the grading awarded to Grant Smith & Company, Portland, Ore., pursuant to the company's plan to push the work to an early completion and store ties in the near future. The company's plans relative to extensive improvements to its store department facilities at Pocatello, Idaho, Rawlins, Wyo., and Grand Island, and Omaha, Nebr., as reported in the June issue, have advanced to the point that it has installed a gantry crane on a 1,000-ft. runway at Pocatello and expects to start in the near future the construction of a 175-ft. addition to the store house at that point as well as a small paint storage cellar. The 7½-mile extension of the Homedale branch of the Oregon Short Line, reported in the June issue, as having been authorized by the Interstate Commerce Commission, is now under construction and will be completed this season. The company expects to start in the near future and complete this season the construction of the Delta-Fillmore branch of the Los Angeles & Salt Lake, but does not contemplate undertaking this year the construction of the proposed terminal facilities at Los Angeles for which property has been acquired, as also reported in the June issue.

This company, noted in the June issue as preparing plans for a $1,000,000 freight station at Denver, Colo., has called for bids on this work. Its superstructure will be of steel, 610 ft. by 70 ft., including two platforms, each 16 ft. by 865 ft. and an automobile unloading shed, 50 ft. by 400 ft.

The Wabash called for bids during the month for the conversion of its combination freight and passenger station at Kirksville, Mo., into a passenger station, and for the construction of a one-story 27-ft. by 136-ft. frame freight house at that point.

Supply Trade News

General

The Air Reduction Sales Company, has consolidated its offices at 120 Broadway and 160 Fifth avenue, New York with the executive office at 342 Madison avenue.

The O'Malley Beare Valve Company has removed its downtown (Chicago) sales and service office from 841 Railway Exchange building to its new general office and manufacturing plant, 231 to 259 East Ninety-fifth street.

Personal

A. A. Murphy has been appointed resident sales manager of the Industrial and Railway Paint and Varnish division of E. I. Du Pont De Nemours & Co., with headquarters at 30 Church street, New York City.

Charles M. Schwab, chairman of the board of directors of the Bethlehem Steel Corporation, has also been elected chairman of the board of the **Chicago Pneumatic Tool Company,** New York, to succeed John R. McGinley, who resigned as chairman but who remains as a director of the company.

C. E. Knickerbocker, regional engineer, Eastern Region, United States Railroad Administration and formerly chief engineer of the New York, Ontario & Western, resigned effective July 1 and has formed a partnership with L. D. Rockwell, under the name of **Knickerbocker & Rockwell,** with office at 2 Rector street, New York City. The new firm will handle railway supplies and various kinds of maintenance specialties.

W. H. White has been appointed New York representative of the Mahr Manufacturing Company, Minneapolis, makers of the Mahrvel line of oil burning equipment. Prior to this connection, Mr. White devoted considerable time to various mechanical work in shops and as a representative and until recently was associated with the Mushet Steel & Taylor Iron interests in the United States and Canada. Mr. White will maintain offices at 56 Murray street, New York.

F. W. Carter, assistant manager of the heavy traction division, railway department, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has resigned to become president of the Louisville Frog & Switch Company at Louisville, Ky. Mr. Carter graduated in electrical engineering from the Virginia Military Institute in 1912 and in the same year entered the employ of the Westinghouse Electric & Manufacturing Company, where he served in various capacities to 1916, when he took up heavy traction work under F. H. Shephard, director of heavy traction, with headquarters at New York. In 1917 Mr. Carter entered military service and served overseas with the Rainbow Division, being awarded the D. S. C. After returning from Military service he re-entered the employ of the Westinghouse Electric & Manufacturing Company, where, under W. R. Stinemetz, manager of the railway sales department, he had charge of heavy traction negotiations up to the time of his recent appointment as president of the Louisville Frog & Switch Company.

F. W. Carter

Colonel Walter J. Riley, president of the O. F. Jordan Company, East Chicago, Ind., has been appointed chairman of the Interstate Harbor Commission, a joint commission of the states of Illinois and Indiana and the United States Government, to consider the development of a harbor in the vicinity of Hammond, Ind., which project when carried out will include extensive rail as well as water terminals.

Jay L. Hench, who resigned recently as Chicago district sales manager of the Lackawanna Steel Company, has organized the **Jay L. Hench & Company,** with offices at 208 South LaSalle street, Chicago, to engage in the purchase and sale of various iron and steel products including steel sheet piling, light and heavy tee rails, sheets, plates, shapes and bars. Mr. Hench was born on April 11, 1885, at Hinsdale, Ill. and attended Cornell University from 1903 to 1905, specializing in iron and steel analysis. From 1905 to 1906 he was employed in the open-hearth and Bessemer departments of the Illinois Steel Company, and from 1906 until 1911 he was connected with the sales department of Joseph T. Ryerson & Son, a position he left in 1911 to become a sales agent of the Lackawanna Steel Company, having jurisdiction over the Indiana and Michigan territory. In May, 1919, he was promoted to district sales manager in charge of the Chicago office, and held this position until his recent resignation.

J. L. Hench.

Trade Publications

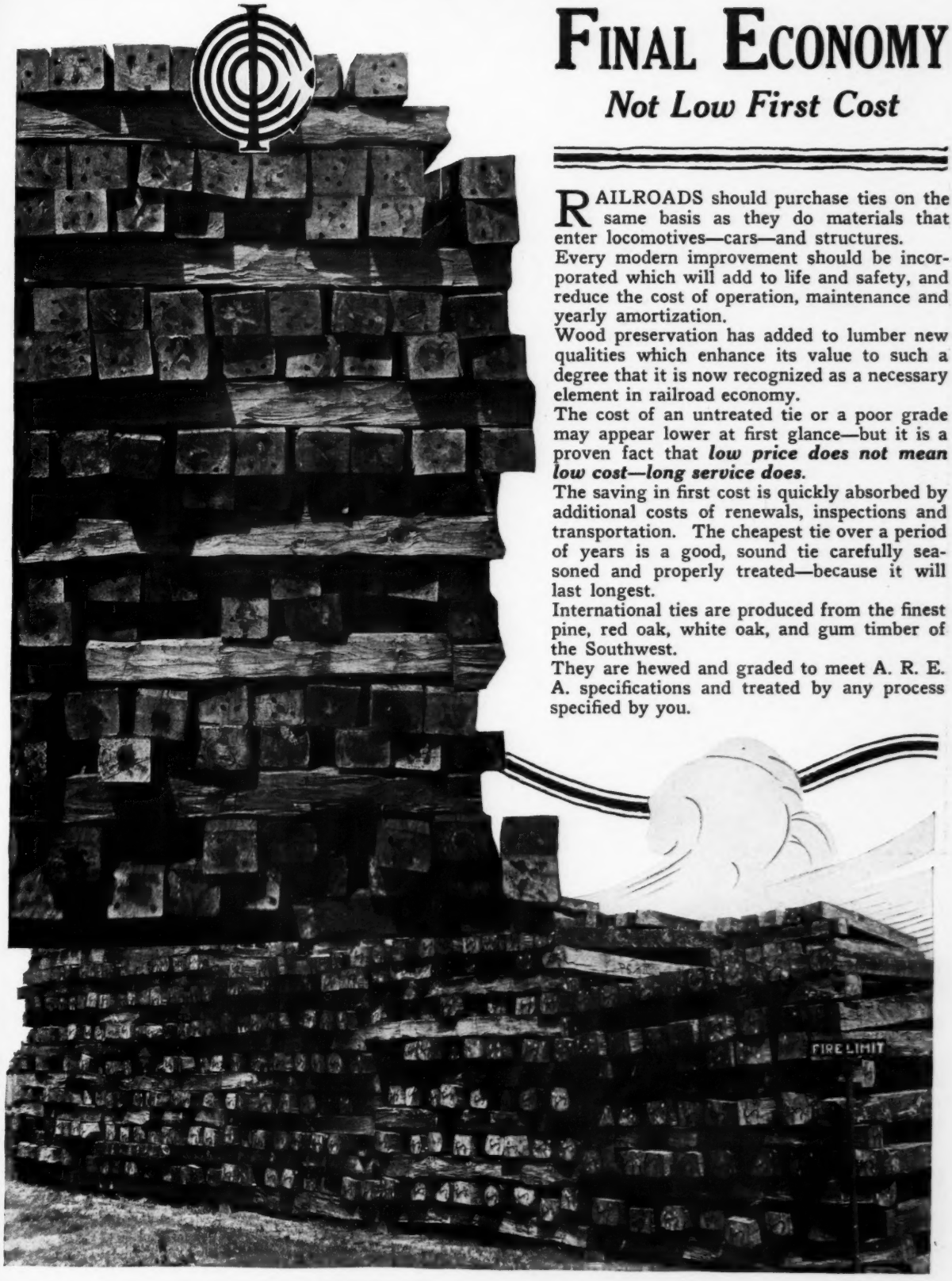
Drag Scrapers.—The Link Belt Company, Chicago, has issued a 24-page illustrated booklet describing the details and application of its power hoe. The illustrations include several plan drawings to illustrate how the equipment may be installed.

Piped Tools.—A 63 page catalog has been issued by the Armstrong Manufacturing Company, Bridgeport, Conn., covering, among other things, its extensive line of pipe threading stocks, pipe tool kits, dies, pipe vises, caps and other fitting tools including the newly developed nipple holder for making right use in threading close nipples.

Adzing and Boring Cross-Ties.—The Century Wood Preserving Company, Pittsburgh, Pa., has issued a large size 8-page bulletin, illustrated, devoted to the adzing and boring of cross-ties before treatment. The bulletin discusses the advantages of adzing and boring all cross-ties before treatment and shows by text and illustrations the different methods which can be used. The machinery for this class of work is also described as well a a typical plant layout.

Architects Specification Handbook.—The Truscon Laboratories, Detroit, Mich., have issued a loose-leaf handbook of specifications, 108 pages of 8½-in. by 11-in. size, covering the use of Truscon waterproofing and dampproofing products, floor hardeners, enamels, paints and varnishes. The book is conveniently prepared for ready use by architects and engineers.

Eliminating Waste in Blasting.—A 48-page illustrated booklet has been issued recently by the Hercules Powder Company, Wilmington, Del., devoted to the question of eliminating waste in various forms of blasting. The text takes up in detail the important factors to be considered and in conjunction with numerous illustrations, describes how the work may be handled with economy. Among the chapters are several devoted to planning, drilling, choosing explosives, firing schedules and systems, etc.



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International ties are produced from the finest pine, red oak, white oak, and gum timber of the Southwest.

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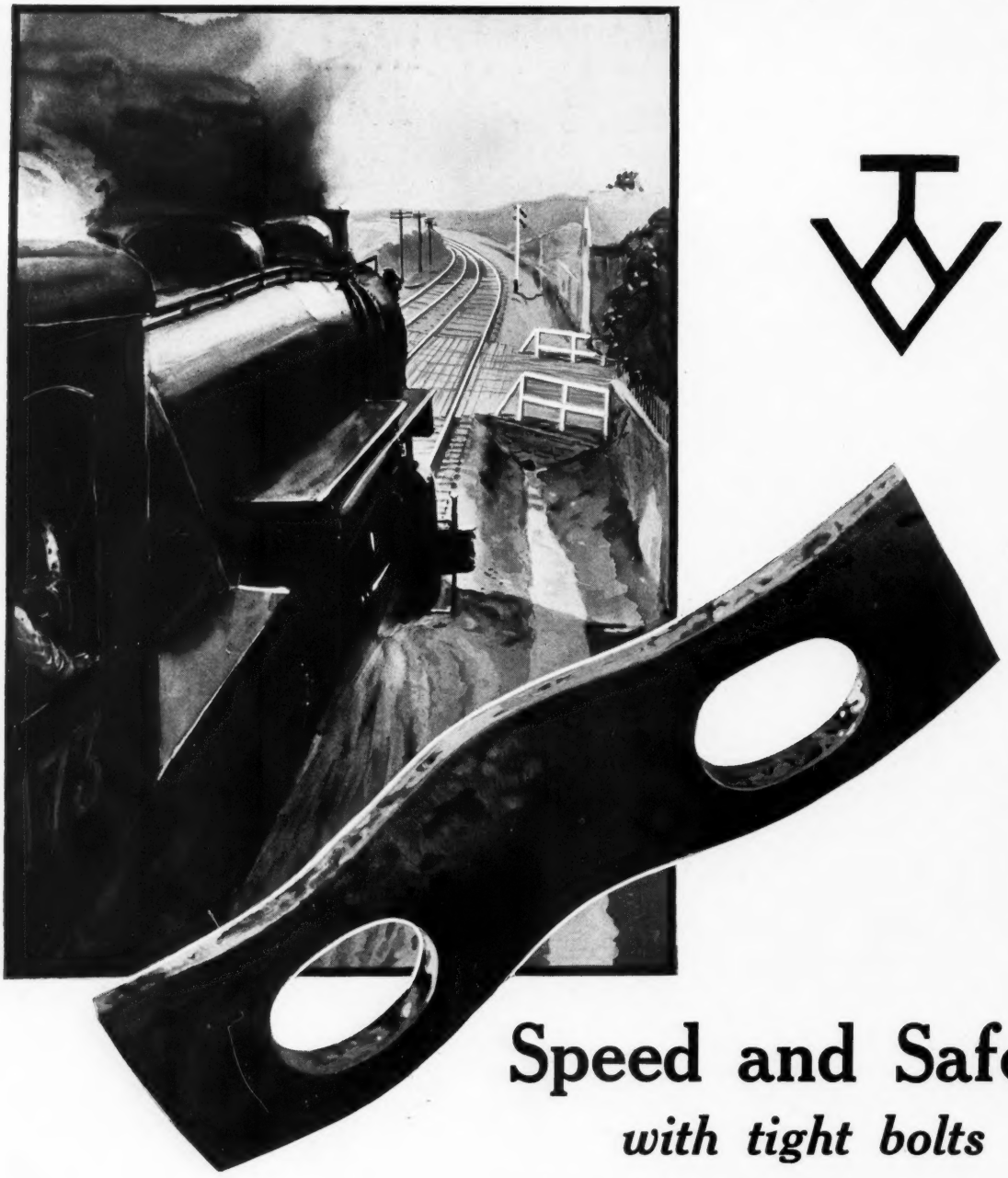
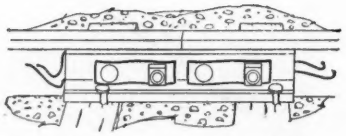


Speed and Safety
with tight bolts

WHEN bolt tightening is neglected or prevented thru strikes or weather, schedules begin to suffer. "Sleigh-bells" are as much a warning to the careful engineer as a danger signal.

The function of Verona Rail Joint Springs is to render tightening almost unnecessary. Loose bolts result from stretch and wear. The springs follow up the stretch and compensate for the wear. Not only does the spring exert infinitely more reactive pressure than any other device, but it exerts this pressure thru a greater distance.

Many roads are trying springs on a stretch of ten miles in every division, and are closely checking the results. We know of no better way of proving the superiority of the Verona Rail Joint Spring.



This illustration shows the Verona Rail Joint Spring in track

VERONA TOOL WORKS — Pittsburgh, Chicago, New York